c 3

MANITOBA MANUFACTURING AND PROCESSING TECHNOLOGY AUDIT

Prepared for:

DEPARTMENT OF INDUSTRY, TRADE AND TECHNOLOGY,
GOVERNMENT OF MANITOBA

And

DEPARTMENT OF REGIONAL INDUSTRIAL EXPANSION,
GOVERNMENT OF CANADA

Project No. 0019-001

Prepared by:

WESTERN OPINION RESEARCH, INC.
711 - 213 Notre Dame Avenue
Winnipeg, Manitoba

March 31, 1985

Page

1. INTRODUCTION 1

1.1 Overview 1
1.2 Overview of Technological Infrastructure 2
1.3 Assembly of Industrial Manufacturing Sector Data Base 3

1.3.1 General 3
1.3.2 Survey Design 3
1.3.3 Interview Process 5
1.3.4 Inputting Information into Data Base 6

1.4 Assessment of Technological Infrastructure 6

2. TECHNOLOGICAL INFRASTRUCTURE 7

2.1 Definition 7
2.2 The Environment for Fostering Technologically Innovative Firms 9
2.3 Conditions for Technological Innovation 11
2.4 Secondary Data Information 12

2.4.1 Agriculture 13
2.4.2 Health. 15
2.4.3 Other Applied Science 18

3. SURVEY RESULTS 26

3.1 Demographics 27

3.1.1 Industry Sectors 27
3.1.2 Head Office 30
3.1.3 Sales 31
3.1.4 Sales Distribution by Region 32
3.1.5 Research and Development. 33
3.1.6 Employee Statistics 35

3.2 Product and Product Development 37

3.2.1 Technological Disciplines 37
3.2.2 Assessment of Product Relative to Other Manufacturers 38
3.2.3 Source of Technical Expertise - Product 39
3.2.4 Product Development Decisions 40
3.2.5 Pressure in Industry for Product Innovation . . 41
3.2.6 Resources Devoted to Product Development . . . 41
3.2.7 CAD and CAE in Product Development 42A

Page

3. SURVEY RESULTS (con't)

3.3 Process Development 43

3.3.1 Technological Disciplines 43
3.3.2 Assessment of Production Process Relative to Other Manufacturers 45
3.3.3 Source of Technical Expertise - Process 46
3.3.4 Process Improvement Decisions 47
3.3.5 Pressure in Industry for Process Innovation . . 48
3.3.6 Resources Devoted to Process Improvement . . . 49
3.3.7 Advanced Systems and Equipment for Production . 51
3.3.8 Occupations Affected by Technological Change . 51

3.4 Information Systems 52

3.4.1 Use of Automated Information Systems 52
3.4.2 Plans for Computer Use 52
3.4.3 Personnel for Operating Information Systems . . 53

3.5 Linkages with other Infrastructure Elements 54

3.5.1 Contribution of Other Organizations to Product/ Process Development 54
3.5.2 Linkages with Manitoba Universities and Colleges 57
3.5.3 Assessment of Training at Universities and Colleges 59
3.5.4 Government Programs Used 61
3.5.5 Suggested Government Programs 64
3.5.6 Inhibitors of Technological Change 66

4. ASSESSMENT OF MANITOBA TECHNOLOGICAL INFRASTRUCTURE . . . 68

4.1 Introduction 68
4.2 Comparison of Manitoba to Others 69

4.2.1 Number of Research and Development Units in Manitoba 69
4.2.2 Comparison to Economic Council of Canada Study of the Manufacturing Sector in Manitoba . . 69
4.2.3 Comparison to 1984 Ontario Technology Centre Study 71

Page

4.0 ASSESSMENT OF MANITOBA TECHNOLOGICAL INFRASTRUCTURE (con't)

4.3 Assessment Relative to Criteria Developed From Technological Infrastructure Review 72

4.3.1 Strong Science-Based Industry 72
4.3.2 Strong Research Universities With Ties to the Industrial Sector 73
4.3.3 Depth in Individual Industry Sectors 73
4.3.4 Depth in Industry Support 74
4.3.5 Access to Financial Services 76
4.3.6 Attractive Market Conditions and/or Market Access 76

4.4 Implications 77

APPENDIX A: QUESTIONNAIRE FORMAT 79

APPENDIX B: RATIONALE FOR SAMPLE SELECTION METHODOLOGY . . . 80

APPENDIX C: SELECTED CROSSTABS FOR SURVEY RESULTS 81

APPENDIX D: SELECTED COMMENTS FROM QUESTIONNAIRE 82

Page

Table 3.1: Industries of Interviewed Firms 28

Table 3.2: Firms Regrouped into Broad Industry Categories . . 29

Table 3.3: Head Office Crosstabulated with Sales 30

Table 3.4: 1984 Sales of Products Produced in Manitoba . . . 31

Table 3.5: Firms Reporting Percentage Sales by Region 32

Table 3.6: Annual Research & Development Expenditures by Firm 33

Table 3.7: Breakdown of R & D Expenditure - Research versus Development 34

Table 3.8: Breakdown of R & D Expenditure - Product Development versus Process Innovation 34

Table 3.9: Component Share of R & D Expenditure 35

Table 3.10: Number of Firms Reporting Employees in Job Classifications 36

Table 3.11: Most Important Technological Disciplines Involved in Product Composition 37

Table 3.12: Assessment of Product Vis-A-Vis Other Manufacturers 38

Table 3.13: Source of Expertise for Product Improvements . . . 39

Table 3.14: Locus for Product Development Decisions 40

Table 3.15: Pressure in Industry for Product Innovation . . . 41

Table 3.16: Human Resources Devoted to Product Development . . 42

Table 3.17: Staff Expertise - Product Development 42

Table 3.18: Most Important Technological Disciplines Involved in the Production Process 44

Table 3.19: Assessment of Process Vis-A-Vis Other Manufacturers 45

Table 3.20: Source of Expertise for Process Improvements . . . 47

		Page
Table 3.21:	Locus for Process Improvement Decisions	48
Table 3.22:	Pressure in Industry for Process Innovation	48
Table 3.23:	Human Resources Devoted to Process Improvement	49
Table 3.24:	Staff Expertise - Process Improvement	50
Table 3.25:	Existence of Advanced Production Systems and Equipment	51
Table 3.25A:	Occupations Affected by Technological Change	51A
Table 3.26:	Automated Information System Use in Functional Areas	52
Table 3.27:	Plans to Upgrade Existing Systems or Install New Systems	52
Table 3.28:	Use of Consulting Versus In-House Personnel for Systems Development	53
Table 3.28A:	Personnel for Information Systems	53A
Table 3.29:	Contribution of Other Organizations to Product Development and Process Innovation	56
Table 3.30:	Linkages with Universities and Colleges	58
Table 3.31:	Suitability of Training at Universities and Colleges	60
Table 3.32:	Federal/Provincial Programs Used	62
Table 3.33:	Government Programs Firms Would Like to See	65
Table 3.34:	What Inhibits Adoption of Technological Innovation	67

1. INTRODUCTION

1.1 Overview

Western Opinion Research, Inc. has completed the initial part of a Technological Audit of the Province of Manitoba for the Departments of Industry, Trade & Technology and Regional Expansion of the governments of Manitoba and Canada respectively.

The study was undertaken to provide a knowledge-based means of assessing industrial technological strengths, weaknesses and opportunities, and as a baseline against which to measure the progress of the current technology adaptation strategy.

To accomplish these objectives the project was set up to be conducted as a two part longitudinal study extending over five years. The work just completed (Part One) was intended to accomplish the following objectives:

1) a comprehensive analysis of the provincial technological infrastructure for economic development purposes.

2) a relevant data base of technological activities in the industrial manufacturing sector, including office communication/information/automation systems. The data base should:

   a) be detailed, quantitative and qualitative, and updateable; and

   b) provide a detailed understanding of the Manitoba technological situation.

   c) measure the effectiveness in Manitoba of federal and provincial technology-related programmes and identify related needs and opportunities. [Authors note: This includes assessment of the technological infrastructure]

Addressing the first objective requires the development and statement of a conceptual overview of Manitoba's technological infrastructure.

This provides a relevant perspective and some background material for the satisfaction of the second objective regarding the collection of relevant in-depth data for industrial manufacturing companies.

The third objective was addressed utilizing the data collected with respect to objectives one and two.

The following tasks were undertaken sequentially:

1) overview of technological infrastructure;
2) assembly of industrial manufacturing sector data base; and
3) assessment of technological infrastructure.

1.2 Overview of Technological Infrastructure

The approach was to use an organizational apporach as the framework for understanding Manitoba's technological infrastructure.

Organizational elements considered were:

- industrial companies;
- universities;
- government agencies;
- suppliers and support services;
- other service sector organizations, as appropriate; and
- the manner of interraction between elements; eg: government policy, use of services, etc.

With this general framework in place, two tasks were completed:

1) collecting macro data on the various elements; and
2) organizing & structuring these data in a useful manner.

The first task of collecting data on various elements of the technological infrastructure involved a compilation of data that were currently and readily available. Individuals from appropriate organizations were contacted by telephone or mail and asked to provide available data regarding the nature and extent of organizational activities, budgets, personnel, etc.

1.3 Assembly of Industrial Manufacturing Sector Data Base

1.3.1 General

This phase represented the bulk of the activity of Part One. It consisted of the collection of more detailed information with respect to the technological activites of 200 industrial manufacturing and/or processing organizations in Manitoba. The focus for collection of in-depth information was upon industrial firms, not universities, government agencies, suppliers or other elements of the technological infrastructure.

Tasks undertaken to complete this phase included:

1) survey design;
2) interviewee selection;
3) interviewing process;
4) inputting information for statistical summary report and data base; and
5) preparation of summary report(s).

1.3.2 Survey Design

The task of survey or questionnaire design initially involved a thorough review of the types of data it was desirable to assemble. The questionnaire used for data collection is included in Appendix A.

A number of people were consulted during the questionnaire design phase of the project. The interview format was pre-tested with five organizations (public and private) prior to its finalization.

Certain areas of technological activity were specified for inclusion in the data base. These included:

- electronic;
- aerospace systems;
- material systems;
- energy technologies;
- manufacturing/production systems; and
- biotechnology.

However, rather than studying a sample of 200 randomly selected firms we focused on the <u>population</u> of the 200 most technologically active firms in Manitoba (Appendix B). The mechanism for identifying these firms was to consult on an individual basis with individuals knowledgeable about industrial manufacturing and processing firms in Manitoba. Discussions were held with more than 10 private firm, association & government representatives. The primary criterion for including a firm in the group/population for interviewing was its perceived potential for significant commercial technological innovation. We also asked people to identify the Manitoba firms that they perceived to be the most technologically innovative.

Factors taken into account in the selection of firms included:

a) the meaning of the term "significant commercial technological innovation"--ie: the application of a technology for the first time by a firm to a new commercial product or process, or, as defined by economist Jacob Schmookler, "When an enterprise produces a good or service or uses a method or input that is new to it, it makes a technical change";

b) the likely commercial impact in terms of the size of the organization (Here it is very important to look at the size of firms; i.e., sales, employees, capital investment). We attempted to set up interviews with most of the larger manufacturing firms in Manitoba;

c) ensuring there was coverage of all potential technical areas and areas of Manitoba's economy. It should be noted that there was diffuculty in identifying 200 Manitoba firms considered capable of significant technological innovation.

1.3.3 Interviewing Process

Interviews were to be conducted with 200 organizations.

Interview statistics are as follows:

Companies contacted		242
Refusals		22
Completed (in-person)		193
Mail outs - received		5
- pending		9
Companies not eligible for survey		12
never manufactured	5	
no longer manufacturing	4	
out of business	3	
Completed surveys		198

Interviewers were a combination of Western Opinion Research Inc. staff & contract interviewers. We tried to recruit, and in most cases had, interviewers capable of handling technological subjects.

The interview process per se involved contacting the potential interviewee and making an appointment to see him/her. This was centrally arranged and managed. The interview which was normally about an hour in duration was then conducted. All interviews were subsequently written up and returned to the interviewee for comment, correction and/or additions. This ensured that comments were correctly recorded.

Generally, the reception from companies was quite good.

1.3.4 Inputting Information into Data Base

As the interviews progressed the individual interviews were edited, coded and entered into the computer for statistical summary.

1.4 Assessment of Technological Infrastructure

The latter part of the project involved conducting an assessment of the technological infrastructure for manufacturing firms in Manitoba. This was done by comparing Manitoba data with available standards or comparative information from other parts of Canada (where & if comparisons were possible). It also involved assessment of the information collected in terms of certain criteria developed from review of the technological infrastructure. Finally, certain evaluative questions were included in the questionnaire and these were reviewed.

It should also be noted that the major assessment will occur when this baseline information is compared with subsequent survey results.

2. TECHNOLOGICAL INFRASTRUCTURE

A concept which has developed in academic and scientific circles over the past two decades is that of a technological infrastructure. Variously termed as a scientific complex, a technology-oriented complex or a technology cluster, the concept that each of these expressions embodies is essentially the same. It is an organizational approach for describing the various elements which contribute to the technological development of a community or region. For our purposes, the term "technological infrastructure" is the most appropriate expression to describe this concept as it implies that an underlying foundation or basic framework exists for the support of technological development.

2.1 Definition

By means of a definition, "technological infrastructure" in the broadest sense includes all elements actively engaged in developing and refining technology or in providing support services to those that are adopting technological innovations. Included in this definition are the following groups:

i) Universities which emphasize a wide range of graduate studies in science, engineering and mathematics and engage in basic and applied research in science and engineering;

ii) Government research facilities administered by government and universities; and,

iii) Science-based industry which includes industrial research and development labs, large and small technically oriented manufacturing operations (ie: those that invest in applying advanced technology to their production), and support services and suppliers.

These are the basic elements which form the nucleus of the infrastructure. From the universities come the trained personnel - graduates and consultants for industry. Basic research and testing facilities are major contributions that universities make to the technological base. Government-sponsored research institutes augment basic research with more specialized and applied expertise to address the particular needs of constituent groups in industry and government.

The key to the exploitation of technological developments are the firms that make up the more science-based sectors of industry. This is a complex amalgamation of competitors and suppliers - small and large, new and old, as well as a support structure of financial and technical groups. More important than the breadth of industrial sectors represented in an economic zone is the depth of the major industries. With a higher degree of industry agglomeration come greater external economies of scale as firms learn from each other and strive to outdo one another. A multi-firm industrial sector enhances the resource base that supplies that sector and others in the economy. A stronger base in terms of the labour market, venture capital, physical infrastructure and technical support will attract other firms to the area and lead to the "spinning off" of new firms from the larger, more established ones. This strengthens the depth of an industrial sector and extends its capabilities and innovativeness.

Entrepreneurs are another element frequently cited as being crucial to technological development on the industrial side. These are individuals who usually begin their careers in technical areas of established industrial or research organizations and at some point decide to branch out on their own with a new product or process idea. Both Silicon Valley and Route 128 around Boston were technology centres that had their start with small companies established by former employees of research facilities. The process of new firm formation is indigenous and largely unsupported. Entrepreneurs with a vision and a driving force start up a company. Whether they succeed depends on a number of factors including management expertise, a commercially-viable technology and product as well as adequate support and resources for sustaining an operation.

2.2 The Environment for Fostering Technologically Innovative Firms

There have been numerous studies conducted on what attracts firms to locate or expand in a particular location. From this material, one can identify several factors which are important in attracting and nuturing technologically-innovative firms. The most commonly identified characteristics are:

- a strong research university;
- a skilled labour pool;
- adequate financing;
- the presence of corporate headquarters;
- good transportation links with other centres;
- a good climate; and
- cultural amenities.

From surveys of corporate management and professional staff, these are the types of factors cited as important in making locational decisions. Therefore, one would assume that the presence of these factors in a particular region would give it the potential to be a technology centre. What has been found in at least one study however, is that many of these factors which have been identified in surveys of executives cannot be confirmed empirically. The most comprehensive empirical study of this type was conducted for the Office of Technology Assessment of the U.S. Congress. Using data from 277 metropolitan areas in the U.S. in 100 high technology industries over the period 1972 - 1977, several hypotheses were tested linking growth with 19 factors similar to those listed above. Most of the factors were not significant, including climate, educational spending, manufacturing wage and degree of unionization. Only three variables were consistently correlated with plant shifts in an expected manner - airport access, level of defense spending and size of labour force. Surprisingly, amenity- related factors such as pollution, housing costs and arts provision had the reverse expected effect on plant location. This report concludes that analysis of factors affecting the development of technologically-oriented firms has to be done on an industry-by-industry basis as the relationship between variables differs from sector to sector.

Furthermore, the existence in a region of a set of characteristics found to be commonly associated with the growth of technological firms does not imply that growth will occur in that region. Therefore, some of these factors may be necessary conditions but are not sufficient conditions for fostering the growth of technologically advanced firms.

2.3 Conditions for Technological Innovation

There are several conditions which have been identified as important factors in generating technological innovation both at the micro level of the firm and at the macro level. In terms of the level of the firm the following conditions have been identified:

(i) a flexible organizational structure;
(ii) a diversity of staff expertise;
(iii) an adequate financial condition;
(iv) a good understanding of market needs;
(v) a good understanding of competitive and other environmental pressures; and
(vi) a willingness to assume risk.

There are other factors which may not in and of themselves lead to innovation, but they can act to facilitate this process. They are rapid growth in the demand for a firm's product and secondly, the existence of financial rewards to workers, owners and managers for improved performance.

At the macro level of the economy, other factors can promote technological innovation:

(i) effective competition among firms, which necessitates risk-taking;
(ii) opportunity for the entry of new firms in established areas or in new areas of business;
(iii) few institutional barriers to taking risks through public regulation or private contracts to protect firms or jobs from competition; and
(iv) mechanisms in firms and in society to generate and to integrate new knowledge and new scientific understanding.

2.4 Secondary Data Information

The following is a summary of data on non-commercial/industrial research organizations available from public sources. There are several indicators of activity which are reported here including:

(i) the types of research being conducted,
(ii) the size of research and development expenditures,
(iii) the number of people associated with its operations,
(iv) the research facilities that the organization has available to it.

These organizations, which are part of the technological infrastructure can be organized into broad categories that classify the nature of their work. The data on the institutes is organized under the following headings: agriculture, health, and other applied science.

2.4.1 Agriculture

I. Manitoba Research Council's Canadian Food Products Development Centre

i) Research/services:

- fee for service consulting in the food, feed and beverage industry
- technical consulting/problem solving
- technology transfer
- factory incubation/pilot production
- assistance with regulatory compliance

ii) Operating budget: $1.5 million in 1984 - 1985

iii) People involved:
- 2 Ph.D.'s in chemistry
- 4 Masters in microbiology, food and nutrition, and library science
- 15 Other technical staff including 13 bachelor degree holders

iv) Facilities:
- chemistry and microbiology labs
- food lab
- pilot plant (1,000 sq. meters)
- library

II. Grain Research Laboratory - Canadian Grain Commission

i) Research/services: a broad based program of basic and applied research on the quality of grains and oilseeds.

ii) R & D Budget: Not reported in 1983 report.

iii) People involved:
- 10 Research scientists
- 8 Chemists
- 33 Scientific support
- 5 Senior technologists
- 1 Statistician

iv) Facilities: full lab facilities including gas chromatography and spectroscopy.

III. Prairie Agricultural Machinery Institute - Portage la Prairie Test Station

i) Research/services: provides physical and analytic testing services for farm machinery manufacturers on models, full-scale prototype and pre-production machines.

ii) Operating budget: $2.8 million in 1983 - 1984
- equipment testing expenditures $2.27 million (includes test stations in Saskatchewan and Alberta as well.)

iii) People involved: NA

iv) Facilities: vibration testing facility
testing facilities for various types of farm machinery

2.4.2 Health

I. Health Sciences Centre Research Foundation

i) Research/services: provides grants to medical doctors and scientists for medical research.

ii) Research budget: approx. $200,000/year in research grants.

iii) People involved: recipients of research grants.

iv) Facilities: none

II. St. Boniface General Hospital Research Foundation Inc.

i) Research/services: provides grants for medical research in a wide range of areas including liver and kidney disease, cancer, Alzheimer's disease, rabies and nursing care.

ii) Research budget: $275,000 for grants in 1984 - 1985

iii) People involved: grant recipients

iv) Facilities: none

III. Winnipeg Rh Institute

i) Research/services:
- development of protein separation technology
- quality control methods development
- protein chemistry
- study of protein functions

ii) Research budget: in excess of $250,000 for 1984 - 1985

iii) People involved:
2 Ph.D.'s
1 Ph.D. student
3 Research associates
3 technologists

iv) Facilities: laboratory facilities for research in protein chemistry

2.4.3 Other Applied Science

I. Cyclotron Laboratory - University of Manitoba

i) Research:
- applied research in the areas of:
  - new target systems for isotope production
  - radioactive emissions from dental procelains
  - design of a proton microprobe system for proton induced X-ray emission work with application to the earth sciences, medicine, biology and other fields.

ii) R & D budget: not available in 1984 Annual Reserach Report

iii) People involved: 10 full time staff
25 graduate students
11 professors funded by the University
15 members of the Physics Department's Mechanical and Electrical Workshops.

iv) Facilities: spiral ridge cyclotron and related mapping apparatus
Narodny linear accelerator.

II. Freshwater Institute - Winnipeg

i) Research/services:
- studies of fish population dynamics
- aquaculture studies aimed at developing techniques for commercial and recreational fish farming
- identification and treatment of infectious diseases specific to freshwater fish
- fish habitat research - study of pollutants and their effect on freshwater ecosystems

ii) R & D budget: not reported in Department of Fisheries and Oceans Annual Report

iii) People involved: not available from published materials

iv) Facilities: analytical sampling laboratory
computerized statistical reporting system
library

III. Manitoba Research Council's Industrial Technology Centre

i) Research/services:
- fee for service consulting in all industrial sectors with the exception of food processing
- includes product and process development, mechanical and industrial engineering, physical testing, and capabilities in chemistry, electronics, biotechnology and metallurgy

ii) Operating budget: $4.5 million in 1985 - 1986

iii) People involved:
5 Ph.D.'s in engineering, computer science, chemistry and biotechnology.
10 masters in various disciplines
18 bachelor degree holders
16 technologists
6 technicians

iv) Facilities: accredited testing organization by Standards Council of Canada
- metallurgy lab
- physical testing lab
- chemistry lab
- electronics lab
- biotechnology lab
- CAE lab
- machine shop

IV. Manitoba HVDC Research Centre - Winnipeg

i) Research/services:
- analytic and developmental research in all areas of HVDC technology including insulation systems, conventional and microprocessor-based control systems, power systems and related computer analysis and software

ii) R & D budget: $657,488 for research projects in 1983 - 1984

iii) People involved: members of: the Faculty of Engineering, U of M
Manitoba Hydro
Teshmont Consultants, Inc.
Federal Pioneer Ltd.

iv) Facilities: have use of laboratories, test equipment, computer services, software programs and libraries of the four sponsors of the Centre.

V. University of Manitoba

i) Research/services:
- research conducted in many disciplines primarily in the medical, agricultural, science and engineering faculties
- specific projects (over $100,000) include:
  - research in cell biology
  - allergy research
  - research in nuclear physics
  - genetic research
  - varietal development in Canola
  - research in health statistics
  - pituitary, placental and brain hormone research
  - research on aging
  - strengthening technical and community services related to nutrition in Ethiopia
  - geophysical research on the precambrian area in Nigeria

ii) Research budget: $32.9 million in sponsored or assisted research in 1983 - 1984
- includes: $22.2 million from federal sources
  $3.0 million from Manitoba government
  $7.6 million from other sources

iii) People involved: no comprehensive list available

iv) Facilites: no comprehensive list available

VI Whiteshell Nuclear Research Establishment - Pinawa

i) Research/services:

Research

- nuclear waste management technology development
- reactor safety research
- medical biophysics
- environment radiation research
- fuels and materials development
- thermal hydraulics research

Services

- neutron activation analysis
- surface analysis
- analytical chemistry
- basic chemistry studies
- health physics and medical research
- environmental impact analysis
- mechanical testing services
- trace analysis services
- metallurgical services

ii) R & D budget: $78 million in 1983 - 1984

iii) People involved: 300 professionals
- chemists, biologists, chemical engineers, physicists, nuclear engineers, ecologists, earth sciences, metallurgists

330 technical - skilled trades

iv) Facilities:

- WR - 1 heavy water reactor,
- "hot cell" facilities capable of handling up to 106 Curies of radioactive material,
- various test "loops" for materials, component and corrosion testing,
- comprehensive metallurgical and mechanical testing facilites with expertise in testing ferrous and non-ferrous metals, ceramics, glasses, rocks and composites,
- expertise in electron microscopy, acoustic emission, fracture mechanics, etc. that can be applied to solving problems involving deformation, hydrogen embrittlement, stress corrosion cracking, creep cracking and fracture,
- extensive analytical chemistry facilities including micro-analytical, radiochemical, neutron activation, mass spectrometry, atomic absorption spectroscopy, plus a unique capability for the characterization of surfaces by such means as scanning electron microscopy, scanning auger microscopy, secondary ion mass spectrometry and photoelectron spectroscopy,
- a research chemistry group adept in the measurement of the thermodynamic properties of solutions at high temperature and pressure, in the application of electrochemical techniques to the study of corrosion and film formation, in the study of gas phase reactions, and in several areas of colloid and surface chemistry,
- combustion test facilities to study the detailed deflagration and detonation behaviour of mixtures of combustible gases from the fundamental chemistry of combustion to engineering scale verification or demonstration experiments,
- environmental research laboratories and field test facilities with experienced staff to study the impact of chemical and radioactive effluents on the environment,
- biophysical research laboratories with expertise in virology, cell biology, radiobiology, biochemistry and biophysics,

- a geotechnical research capability which, by 1986, will include an underground research laboratory for excavation damage experiments for different excavation techniques, development of in-situ stress measurement techniques, evaluation of rock thermal/mechanical properties, hydraulic conductivity and rock porosity measurements and various geochemistry experiments,

- expertise in modelling fluid heat transport systems and high pressure steam/water behaviour,

- consulting service groups encompassing nuclear engineering, risk analysis development of computer models, mathematical analyses and meteorological assessments.

3. SURVEY RESULTS

Some of the data collected from the questionnaire were coded and placed in a data base for statistical analysis. This section reports the results from aggregating these data. It should be emphasized that an aggregated study of this type is to determine the norms and distribution of a population, not to highlight and explain specific observations.

The interviews were conducted over a five week period from mid-February through the third week of March, 1985. The responses of 198 firms are included in this analysis. While most firms answered all of the questions, there were several firms for whom some sections of the questionnaire did not apply. There were also certain sections or questions that some firms viewed as requesting confidential information, so they did not respond. In the accompanying tables, these responses are recorded as N/A, refused or 0 depending on the question.

3.1 Demographics

3.1.1 Industry Sectors

Table 3.1 indicates the wide range of industries in which Manitoba manufacturers are represented. The respondents specified which industry most accurately encompasses the nature of their company's operations. Some thirty-seven industries were mentioned with the greatest concentration of firms being in food processing, electronics, metalwork, plastics, clothing and printing industries. While some industries, such as electronics, have a great number of firms, the relative size of these firms is much smaller than in some other industries such as clothing. Therefore, these figures can be somewhat misleading in terms of understanding the relative importance of each of these industries to the Manitoba economy.

TABLE 3.1

INDUSTRIES OF INTERVIEWED FIRMS

INDUSTRY	FREQUENCY	PERCENT
Aerospace	5	2.5
Batteries	1	.5
Castings	3	1.5
Chemical Products	6	3.0
Clothing	11	5.6
Construction Supplies	7	3.5
Electrial	9	4.5
Electronics	23	11.6
Engines	2	1.0
Fans	1	.5
Farm Equipment	7	3.5
Farm Supplies	1	.5
Fibreglass	3	1.5
Food Processing	25	12.6
Furnaces	4	2.0
Furniture	5	2.5
Machining	5	2.5
Medical Products	4	2.0
Metalwork	18	9.1
Mines	4	2.0
Paint	3	1.5
Plastics	13	6.6
Printing	11	5.6
Pulp and Paper	1	.5
Refrigeration Equipment	5	2.5
Telecommunications	5	2.5
Testing Equipment	2	1.0
Transportation	7	3.5
Utilities	1	.5
Canvas	1	.5
Plasma and Flame Coatings	1	.5
Aircraft	1	.5
Research and Development	1	.5
Biopharmaceuticals	1	.5
Nuclear	1	.5
TOTAL NUMBER OF FIRMS	198	100.0

Valid Cases 198
Missing Cases 0

For the purpose of cross-tabulations, industries were regrouped into eight broader categories. Regrouped, they appear in Table 3.2.

TABLE 3.2

FIRMS REGROUPED INTO BROAD INDUSTRY CATEGORIES

INDUSTRY CATEGORY	FREQUENCY	PERCENT
Chemical Based	28	14.1
Wood Based	17	8.6
Metals and Mines	32	16.2
Machinery and Transportation	39	19.7
Electrical	38	19.2
Food Processing	25	12.6
Clothing	11	5.6
Nonmanufacturing and Other	8	4.0
TOTAL NUMBER OF FIRMS	198	100.0

Valid Cases 198
Missing Cases 0

NOTE: The Industries from Table 3.1 were regrouped in the following manner:

Chemical Based:	Chemical Products, Farm Supplies, Fibreglass, Paint, Plastics, Plasma and Flame Coatings, Biopharmaceuticals.
Wood Based:	Furniture, Printing, Pulp and Paper
Metals and Mines:	Castings, Metalwork, Mines, Construction Supplies
Machinery and Transportation:	Aerospace, Engines, Fans, Farm Equipment, Furnaces, Machinery, Refrigeration Equipment, Testing Equipment, Transportation, Aircraft
Electrical:	Batteries, Electrical, Electronics, Telecommunications
Food Processing:	Same
Clothing:	Same
Nonmanufacturing and Other:	Medical products, Utilities, Canvas, Nuclear, Research & Development

3.1.2 Head Office

Nearly three-quarters of all firms interviewed indicated that their head office was in Manitoba and an additional 20 percent specified a location elsewhere in Canada. Fifteen companies representing 7 percent of the total firms reported that their head offices were outside of Canada. Crosstabulation between sales and head office indicate that none of the foreign-based companies interviewed reported sales of over $100 million whereas 4 Manitoba-based and 5 Canadian-based firms indicated sales of over $100 million (Table 3.3).

TABLE 3.3

HEAD OFFICE CROSSTABULATED WITH SALES

HEAD OFFICE	ALL FIRMS		LESS THAN $10 MILLION		$10 MILLION - $100 MILLION		OVER $100 MILLION		NOT REPORTED	
	Total	%	Total	%	Total	%	Total	%	Total	%
Manitoba	145	(73%)	103	(52%)	31	(16%)	4	(2%)	7	(4%)
Canada	38	(19%)	14	(7%)	15	(8%)	5	(3%)	4	(2%)
U.S	14	(7%)	6	(3%)	6	(3%)	0	(0%)	2	(1%)
Other	1	(1%)	0	(0%)	0	(0%)	0	(0%)	1	(0%)
	198		122		52		9		14	

3.1.3 Sales

TABLE 3.4

1984 SALES OF PRODUCTS PRODUCED IN MANITOBA

SALES ('000)	FREQUENCY	PERCENT
Less than $500	24	12
$500 - $999	18	9
$1,000 - $1,999	18	9
$2,000 - $4,999	32	16
$5,000 - $9,999	31	16
$10,000 - $19,999	23	12
$20,000 - $49,999	24	12
$50,000 - $99,999	5	3
$100,000 - $499,999	8	4
$500,000 and over	1	1
Not available	6	3
Refused	8	4
TOTAL	198	100

The majority of firms interviewed have sales of between two and fifty million dollars. Thirty percent of the firms have sales of less than $2 million and less than ten percent have sales over $50 million.

3.1.4 Sales Distribution by Region

TABLE 3.5

FIRMS REPORTING PERCENTAGE SALES BY REGION

PERCENT OF TOTAL SALES	REGION									
	MANITOBA		WESTERN CANADA		EASTERN CANADA		UNITED STATES		REST OF WORLD	
	No.	%	No.	%	No.	%	No	%	No	%
None	15	(8%)	34	(17%)	59	(30%)	85	(43%)	147	(74%)
1 - 5	29	(15%)	20	(10%)	25	(13%)	31	(16%)	24	(12%)
6 - 10	23	(12%)	22	(11%)	20	(10%)	24	(12%)	10	(5%)
11 - 20	29	(15%)	35	(18%)	28	(14%)	14	(7%)	7	(4%)
21 - 50	43	(22%)	64	(32%)	53	(27%)	28	(14%)	7	(4%)
51 - 75	27	(14%)	19	(10%)	10	(5%)	11	(6%)	1	(1%)
Over 75	32	(16%)	4	(2%)	3	(2%)	5	(3%)	2	(1%)
	198	100%	198	100%	198	100%	198	100%	198	100%

Very few companies sell primarily in Manitoba. Only 16 percent of companies make 75 percent or more of their sales in the province. While 17 percent of firms don't sell products in the other western provinces, 32 percent sell between 21 and 50 percent of their output in that region versus 22 percent of firms selling the same percent in Manitoba. For Eastern Canada, 30 percent of firms don't register any sales but 27 percent have sales between 21 and 50 percent in that region. Fifty-seven percent of firms sell to the U.S. market but for 61 percent of these firms, U.S. sales represent 20% or less of their business. Some 14 percent of these firms have exports to the U.S. of over 50 percent of their total sales. Sales to the rest of the world are restricted to only a handful of firms; however there are 7 firms that sell almost exclusively to foreign markets (Table 3.5).

3.1.5 Research & Development

TABLE 3.6

ANNUAL RESEARCH & DEVELOPMENT EXPENDITURES BY FIRM

THOUSANDS OF DOLLARS	FREQUENCY	PERCENT	CUMULATIVE PERCENT
0 or not available	49	24.7	24.7
Less than 50	62	31.3	56.1
50 - 99	14	7.1	63.1
100 - 199	28	14.1	77.3
200 - 299	14	7.1	84.3
300 - 399	8	4.0	88.4
400 - 499	6	3.0	91.4
Over 500	15	7.6	99.0
Refused	2	1.0	100.0
TOTAL	198	100.0	

One quarter of all firms either do not spend money on R & D or cannot say how much is spent. Another third spend less than $50,000 per year (Table 3.6).

In terms of the breakdown of the expenditure between research and development, Table 3.7 indicates that one-third of firms that spend money on R & D do no research while another third allocate less than 25 percent to this purpose. All but one of these 150 firms spend some money on development. In fact, three-quarters of the companies put a majority of their money into development.

Table 3.8 indicates the breakdown between product development and process innovation. Product development expenditure is predominant with one-quarter of all reporting firms devoting all of their R & D to product and another quarter spending 75 to 99 percent on this area. Consequently the proportion spent on process innovation is significantly less.

TABLE 3.7

BREAKDOWN OF R & D EXPENDITURE - RESEARCH VERSUS DEVELOPMENT

PERCENT OF TOTAL	RESEARCH		DEVELOPMENT	
	Frequency	Percent	Frequency	Percent
0	52	34.7	1	0.7
1 - 25	50	33.3	5	3.3
26 - 50	37	24.7	34	22.7
51 - 75	6	4.0	23	15.3
76 - 99	4	2.7	35	23.3
100	1	0.7	52	34.7
	150	100.0	150	100.0

TABLE 3.8

BREAKDOWN OF R & D EXPENDITURE
PRODUCT DEVELOPMENT VERSUS PROCESS INNOVATION

PERCENT OF TOTAL	PRODUCT DEVELOPMENT		PROCESS INNOVATION	
	Frequency	Percent	Frequency	Percent
0	8	5.6	34	23.8
1 - 25	13	9.1	49	34.3
26 - 50	32	22.4	36	25.2
51 - 75	20	14.0	10	7.0
76 - 99	36	25.2	6	4.2
100	34	23.8	8	5.6
	143	100.0	143	100.0

To get some idea of what the interviewees considered to be R & D expenditures, they were asked what proportion several components would represent in their R & D estimate. Wages were by far the largest expenditure, followed by materials, equipment, fees and facilities (Table 3.9).

TABLE 3.9

COMPONENT SHARE OF R & D EXPENDITURE

PERCENT OF TOTAL	WAGES		EQUIPMENT		MATERIALS		FEES		FACILITIES	
	No.	%	No.	%	No.	%	No.	%	No.	%
None	3	(2%)	47	(33%)	32	(22%)	68	(48%)	85	(59%)
1 - 25	15	(10%)	75	(52%)	88	(62%)	59	(41%)	50	(35%)
26 - 50	47	(33%)	16	(11%)	18	(13%)	9	(6%)	7	(5%)
51 - 75	45	(31%)	3	(2%)	4	(3%)	2	(1%)	0	(0%)
76 - 99	24	(17%)	2	(1%)	0	(0%)	1	(1%)	0	(0%)
100	9	(6%)	0	(0%)	1	(1%)	4	(3%)	1	(1%)

Total firms 143

3.1.6 Employee Categories

Table 3.10 summarizes the employment statistics reported in the various occupational categories. In the scientist category, 22 firms report having chemists, 7 had agronomists or food scientists, and 5 had biologists or microbiologists. Beyond electrical and mechanical engineers, other types of engineers mentioned by firms included chemical (12), civil (10), industrial, (3), metallurgical (3) and stationary (1).

TABLE 3.10

NO. OF FIRMS REPORTING EMPLOYEES IN JOB CLASSIFICATIONS

NO. OF EMPLOYEES	ENGINEERS				SCIENTISTS	COMPUTER SPECIALISTS	TECHNOLOGIST	TECHNICIAN	MGR. PRODUCTION	MKTG.	ADMIN./ OTHER
	Electrical	Mechanical	Other	Total							
None	147	117	154	83	164	110	97	89	19	19	54	19
1	19	42	17	43	11	37	30	19	30	7	30	19
2	8	9	10	22	7	14	19	21	29	4	23	24
3 - 4	8	12	5	17	4	17	22	22	40	9	34	31
5 - 6	2	5	3	8	1	3	9	24	27	3	17	20
7 - 10	4	3	0	7	2	7	2	3	22	10	12	21
11 - 15	0	3	2	5	2	2	5	5	9	10	4	15
16 - 20	2	0	0	2	0	0	1	2	6	10	4	7
21 - 30	1	0	0	0	0	0	1	2	4	22	2	13
31 - 40	0	1	1	2	1	1	2	1	1	10	6	9
41 - 50	0	0	0	0	0	0	2	1	3	15	4	5
51 - 100	1	0	0	3	0	0	1	2	0	27	1	7
101 - 150	0	0	0	0	0	0	0	1	0	13	1	3
151 - 200	0	0	0	0	0	0	0	0	0	10	0	1
Over 200	0	0	0	0	0	1	1	1	2	22	0	3
Refused N/A	6	6	6	6	6	6	6	6	6	7	7	6
TOTAL FIRMS	198	198	198	198	198	198	198	198	198	198	198	198

3.2 Product and Product Development

3.2.1 Technological Disciplines

The first question asked in the product section was to identify the most important technological disciplines involved in the company's major products. Table 3.11 indicates the number of firms that specified each technological area as first, second and third most significant respectively. Mechanical and industrial engineering was specified by the greatest number of firms followed by materials, design/packaging and electronics.

TABLE 3.11

MOST IMPORTANT TECHNOLOGICAL DISCIPLINES INVOLVED IN PRODUCT COMPOSITION

TECHNOLOGICAL DISCIPLINES	NO. OF FIRMS - DEGREE OF IMPORTANCE 1st	2nd	3rd	TOTAL
Electrical	12	19	7	38
Electronics	25	12	11	48
Mechanical/Industrial Engineering	51	37	12	100
Design/Packaging	20	29	22	71
Chemical	19	10	5	34
Materials	30	38	20	88
Biotechnology	2	1	1	4
Food Science	14	4	3	21
Information Processing	5	7	10	25
Energy/Energy Conservation	4	4	7	15
Nuclear	2	0	0	2
Other	12	7	6	25
None	2	30	94	—
	198	198	198	

3.2.2 Assessment of Product Relative to Other Manufacturers

In terms of how Manitoba firms rate their major product development activities vis-a-vis other manufacturers in Canada, fifty-three percent of respondents considered their product more more advanced and forty-three percent said it was the same as other manufacturers of similar products in Canada. Only three percent indicated that their product was less advanced.

When the context was broadened to include other manufacturers in the rest of the world, fewer considered that their product was more advanced while half said it was the same. Only twelve percent reported that their product was less advanced. (Table 3.12)

TABLE 3.12

ASSESSMENT	IN CANADA No.	IN CANADA Percent	IN REST OF WORLD No.	IN REST OF WORLD Percent
More advanced	102	(53%)	57	(29%)
Same	83	(43%)	101	(52%)
Less advanced	6	(3%)	24	(12%)
Don't know	1	(0%)	12	(6%)
	192	100%	194	100%

Crosstabular analysis of the companies' responses to the question of their product compared to the rest of the world with their head office, sales volume and R & D expenditure indicated no striking patterns or variations. (See Tables 2 to 4 in Appendix C). Compared by industry, food processors and electrical-related companies regard themselves as the most advanced with wood-based companies as the least advanced. A majority of firms in the metals and mines, chemical-based and clothing industries regarded their product as the same as manufacturers in the rest of the world. (See Table 5 in Appendix C.)

3.2.3 Source of Technical Expertise - Product

Sixty-four percent of firms stated that they have been very active in introducing technological improvements to their major products. Another twenty-seven percent said they had been somewhat active. This suggests that most companies had a source of technical expertise that they drew upon to make these product improvements. Only nine percent said they were not active.

TABLE 3.13

SOURCE OF EXPERTISE FOR PRODUCT IMPROVEMENTS

	1st	2nd	3rd
In Manitoba:			
In Organization	121 (61%)	31 (16%)	4 (2%)
Outside Organization	11 (5%)	23 (12%)	17 (9%)
Outside Manitoba:			
In Organization	24 (12%)	26 (13%)	4 (2%)
Outside Organization	34 (17%)	46 (23%)	18 (9%)
None/NA	8 (4%)	72 (36%)	155 (78%)
	198	198	198

From Table 3.13, the most important source of expertise for product improvement was within a company's organization in Manitoba. The second most important source was outside the organization and outside the province. Several firms cited trade shows and journals as the kinds of sources they would include in this category. The least important source was outside the firm's organization but in Manitoba.

In crosstabular analysis between head office and the most important source of expertise, it was only firms with head offices in Canada but outside Manitoba that drew heavily upon their parent for technical expertise in this area. (See Table 6 in Appendix C.) Manitoba-based firms relied primarily on their own resources.

Comparing the response to this question with sales volume, it is the smallest and largest firms which rely most heavily on expertise in their company in Manitoba whereas for medium-sized firms ($10 - $20 million in annual sales) there was a markedly higher reliance on services outside the firm and outside the province (43.5% of all firms in this range versus an average of 17.2% for all firms as the most important source; see Table 7 in Appendix C.)

3.2.4 Product Development Decisions

A question on the autonomy of a company's product development decisions revealed that 80 percent of all companies make those decisions within their Manitoba operations (Table 3.14).

TABLE 3.14

LOCUS FOR PRODUCT DEVELOPMENT DECISIONS

	Frequency	Percent
In Manitoba	158	79.8
Outside Manitoba	31	15.7
Both	4	2.0
N/A	5	2.5
	198	100.0

Comparing this response with location of head office indicates that companies with head offices elsewhere in Canada have less autonomy (34.2%) as compared to companies with head offices in the U.S. (50.0%). (See Table 8 in Appendix C.)

3.2.5 Pressure in Industry for Product Innovation

TABLE 3.15

	FREQUENCY	PERCENT
Strong	140	70.7
Neutral	48	24.2
Weak	5	2.5
N/A	5	2.5
	198	100.0

The pressure for product innovation is strong or very strong in the assessment of 71 percent of firms interviewed. Very few (2.5 percent) perceived it as being weak (Table 3.15).

3.2.6 Resources Devoted to Product Development

The number of staff years a company devotes annually to product development was two or less for seventy percent of all firms interviewed. Some twenty percent have three to six staff years while only four percent of firms allocate fifteen or more staff years to this purpose.

TABLE 3.16

HUMAN RESOURCES DEVOTED TO PRODUCT DEVELOPMENT
(in staff years)

Staff Years	Frequency	Percent	Cum. Percent
None	48	24.2	24.2
Less than 1	45	22.7	47.0
1 - 2	46	23.2	70.2
3 - 4	21	10.6	80.8
5 - 6	20	10.1	90.9
7 - 8	6	3.0	93.9
9 - 10	3	1.5	95.5
11 - 12	1	.5	96.0
Over 15	8	4.0	100.0
TOTAL	198	100.0	

The expertise of those who work on product development is mechanical and industrial engineering for most firms. Design electronics and materials are the next most frequently cited areas.

TABLE 3.17

STAFF EXPERTISE - PRODUCT DEVELOPMENT

	1st	2nd	Total
Electrical	8	9	17
Electronics	20	9	29
Mechanical/Industrial Engineering	48	15	63
Design/Packaging	27	12	39
Chemical	11	5	16
Materials	8	22	30
Biotechnology	3	0	3
Food Science	4	6	10
Information Processing	5	5	10
Energy/Energy Conservation	2	1	3
Nuclear	1	1	2
Other	14	12	26
None/No response	47	101	—
	198	198	

3.2.7 CAD and CAE in Product Development

In the products section interviewees were asked specifically whether they had computer-aided design or computer-aided engineering for product development. Some 39 firms or 19.9% of respondents have CAD. Companies with CAE numbered 28 or 14.3% of respondents.

3.3 Process Development

3.3.1 Technological Disciplines

Respondents were asked what technological disciplines were of greatest importance in the production process. Table 3.18 details the interviewee responses to this question. Manufacturing was broken into three stages - materials handling/production scheduling, assembly/processing and testing. While a quarter of the firms had no response to the first stage, those that did indicated that mechanical/industrial engineering and information processing are the two most important technologies necessary for materials handling and production scheduling in their operations. Mechanical and industrial engineering is even more prominent at the assembly/processing stage with over half of the firms identifying it as one of the two most important technological disciplines for their company. Electronics was also an important element in processing for a quarter of the firms. In the testing area, mechanical/industrial engineering and electronics were again the most frequently cited technologies, followed by chemical and electrical.

TABLE 3.18

MOST IMPORTANT TECHNOLOGICAL DISCIPLINES INVOLVED IN THE PRODUCTION PROCESS

	MATERIALS HANDLING/ PRODUCTION SCHEDULING			ASSEMBLY/PROCESSING			TESTING		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Electrical	2	5	3	12	16	7	19	8	3
Electronics	13	15	3	25	19	8	28	12	5
Mechanical/Industrial Engineering	47	15	12	77	26	8	35	13	6
Design/Packaging	4	9	8	10	17	10	7	2	4
Chemical	7	2	2	13	7	4	19	10	6
Materials	22	21	8	12	20	9	12	14	8
Biotechnology	0	1	0	2	2	0	2	8	1
Food Science	1	4	1	4	3	1	13	5	4
Information Processing	38	16	6	7	14	10	1	10	6
Energy/Energy Conservation	1	1	1	1	2	4	1	0	2
Nuclear	0	0	0	0	0	0	0	0	0
Other	7	1	1	16	7	3	18	3	1
None	56	108	153	19	65	134	43	113	152

Total Firms 198

3.3.2 Assessment of Production Process Relative to Other Manufacturers

Interviewee assessments of the state of their production process relative to other manufacturers of similar products elsewhere reveals that fewer companies felt that they are more advanced in this area than they felt about their product. (Section 3.2.2). Whereas 53 percent said their product is more advanced than its Canadian competitors, only 31 percent felt their manufacturing process is more advanced. Fifty-two percent of respondents felt that their production process is the same while 16 percent felt it is less advanced. This compares with 43 and 3 percent respectively for the assessment of their product with other Canadian manufacturers (Table 3.19).

Assessing their production process with manufacturers worldwide, 20 percent of interviewees felt that their company's production process is more advanced versus 29 percent more advanced for their product. Forty-four percent felt their process is the same and 30 percent feel it is less advanced relative to world manufacturers. This compares with 52 and 12 percent respectively for the evaluation of their product with producers in the rest of the world (Table 3.19).

TABLE 3.19

ASSESSMENT OF PROCESS VIS-A-VIS OTHER MANUFACTURERS

ASSESSMENT	IN CANADA		IN REST OF WORLD	
	No.	%	No.	%
More Advanced	59	31.4	38	20.0
Same	97	51.6	83	43.7
Less Advanced	30	16.0	57	30.0
Don't know	2	1.1	12	6.3
NUMBER OF FIRMS	188	100.0	190	100.0

Crosstabulating these results by industry indicate that the food processors and clothing manufacturers rate their production systems more highly than do firms in other industry sectors both in terms of other manufacturers in their industry in Canada and those in the rest of the world. (See Tables 9 and 10 in Appendix C.) Crosstabs by head office, sales volume, and R & D indicated no discernible pattern to their responses. (See Tables 11, 12 and 13 in Appendix C.)

3.3.3 Source of Technical Expertise - Process

Fewer interviewees stated that they have been very active in introducing technological improvements to their production process than in making product improvements. However, there were still 54 percent or respondents who indicated that they have been very active in this area. An additional 32 percent were somewhat active. Only 13 percent said they were not active in improving the production process.

The source of the technical expertise can be seen in Table 3.20. Again the primary source of technical expertise for almost sixty percent of firms is in their organization in Manitoba. The next most important source is both outside the organization and outside the province. Much less important sources are a firm's organization outside Manitoba and outside the organization in Manitoba.

Crosstabular analysis of sources with head office and sales volume indicate no major surprises. Companies with head offices in Canada and the U. S. draw upon the technical expertise of their parent or sister operations with 29% of these firms indicating this as the most important source of production expertise. Again, medium-sized companies ($10 - $20 million in annual sales) rely more heavily on sources outside the firm and outside the province than do small and larger firms. (See Tables 14 and 15 in Appendix C.)

TABLE 3.20

SOURCE OF EXPERTISE FOR PROCESS IMPROVEMENTS

	1st		2nd		3rd	
	No.	%	No.	%	No.	%
In Manitoba:						
In Organization	115	(58.1)	25	(12.6)	6	(3.0)
Outside Organization	11	(5.6)	30	(15.2)	14	(7.1)
Outside Manitoba:						
In Organization	20	(10.1)	21	(10.6)	6	(3.0)
Outside Organization	44	(22.2)	40	(20.2)	21	(10.6)
None/NA	8	(4.0)	82	(41.4)	151	(76.3)
	198		198		198	

3.3.4 Process Improvement Decisions

In making improvements in the production process, over 80 percent of decisions are taken in Manitoba. Only 9 percent were made elsewhere and 6 percent were joint decisions between the local operation and the head office.

TABLE 3.21

LOCUS FOR PROCESS IMPROVEMENT DECISIONS

	FREQUENCY	PERCENT
In Manitoba	163	82.3
Outside Manitoba	17	8.6
Both	11	5.6
N/A	7	3.6
	198	100.0

Companies with head offices in Canada are more likely to have process improvement decisions made by their head office (36.8%) compared to companies with U.S. parents (7.1%). (See Table 16 in Appendix C.)

3.3.5 Pressure in Industry for Process Innovation

TABLE 3.22

	FREQUENCY	PERCENT
Strong	141	71.2
Neutral	35	17.7
Weak	15	7.6
N/A	7	3.5
	198	100.0

Another indicator of the importance of production process improvements is that 71 percent of firms feel that the pressure to make such improvements is strong whereas only 24 percent feel it is neutral and 3 percent feel it is weak (Table 3.22).

3.3.6 Resources Devoted to Process Improvement

Annual staff years devoted to process improvement ranged from 22 percent of respondents stating none to four percent indicating 15 or more. The majority of firms allocate less than 2 staff years for this purpose. These results are very similar to those in section 3.2.6 on resources devoted to product development.

TABLE 3.23

HUMAN RESOURCES DEVOTED TO PROCESS IMPROVEMENT
(in staff years)

STAFF YEARS	FREQUENCY	PERCENT	CUM. PERCENT
None	45	22.7	22.7
Less than 1	47	23.7	46.5
1 - 2	52	26.3	72.7
3 - 4	21	10.6	83.3
5 - 6	13	6.6	89.9
7 - 8	3	1.5	91.4
9 - 10	6	3.0	94.4
11 - 12	1	.5	94.9
13 - 14	0	0.0	94.9
15 and over	10	5.1	100.0
TOTAL	198	100.0	

For over half of the companies, mechanical and industrial engineering is the most important expertise of the staff that contribute to process improvement. Electronics, design and materials expertise were the next most important sources in descending order.

TABLE 3.24

STAFF EXPERTISE - PROCESS IMPROVEMENT

	1st	2nd	Total
Electrical	6	9	15
Electronics	18	9	27
Mechanical/Industrial Engineering	90	21	111
Design/Packaging	8	14	22
Chemical	1	10	11
Materials	8	11	19
Biotechnology	1	1	2
Food Science	4	3	7
Information Processing	3	8	11
Energy/Energy Conservation	0	1	1
Nuclear	0	0	0
Other	17	16	33
None	42	95	—
	198	198	

3.3.7 Advanced Systems and Equipment for Production

Table 3.25 summarizes whether or not firms have various sophisticated production systems or equipment in their operations. Two items - flexible manufacturing system and computer integrated manufacturing - were deleted due to problems with the interpretation of what the terms mean.

TABLE 3.25

EXISTENCE OF ADVANCED PRODUCTION SYSTEMS AND EQUIPMENT

	HAVE		DON'T HAVE	
Robots:				
- with machine vision	7	(4%)	188	(96%)
- with tactile sensors	8	(4%)	187	(96%)
- with artificial intelligence	2	(1%)	193	(99%)
Computer-aided design (CAD)	30	(15%)	165	(85%)
Computer-aided manufacturing (CAM)	36	(18%)	159	(82%)
Zero force cutting systems	4	(2%)	190	(98%)
Integrated process control and quality assurance	72	(37%)	123	(63%)
Ultrasonics	22	(11%)	173	(89%)
High speed machining (over 40,000 rpm)	8	(4%)	187	(96%)

3.3.8 Occupations Affected by Technological Change

Interviewees were asked about the jobs that had been affected the most by technological change during the past five years. (See Table 3.25A) While 54 said there hadn't been any changes due to this factor, most reported some changes. Most negatively affected were production workers with 33 firms having reported reductions in one or more occupational areas. The primary reason for the reductions was automation of previously manual tasks. Unskilled personnel and traditional/conventional tradesmen or production

operators were those mentioned most frequently as being reduced. On the other hand, 37 firms reported a positive change in the production area with machinists and production workers mentioned most often.

Almost all other occupations were only positively affected by technological change. Computer operators, engineering, maintenance, marketing and management were mentioned as occupations having increased in the last five years with very few decreases cited.

Several companies stated that although many of the jobs have undergone changes in their complexity or have been eliminated, the personnel who previously had been in those jobs have been retrained and kept within the company. Technological change that has reduced labour input has led several companies to lower production costs which have allowed them to increase their sales and maintain or expand their labour force.

See Appendix D for the responses of interviewees to this question categorized by occupation group.

TABLE 3.25A

OCCUPATIONS AFFECTED BY TECHNOLOGICAL CHANGE

		Firms Reporting: Positively Affected	Negatively Affected
Production Workers		37	33
Computer-related		10	2
Marketing/Management		5	0
Testing		1	2
Packaging		1	1
Maintenance		4	1
Engineers/Designers		8	1
Other		11	18
No change	70		
No response	17		

3.4 Information Systems

3.4.1 Use of Automated Information Systems

Table 3.26 indicates the area in which computer systems are used presently.

TABLE 3.26

AUTOMATED INFORMATION SYSTEM USE IN FUNCTIONAL AREAS

AREA OF OPERATIONS	USE		DON'T USE	
Inventory Control	116	(59%)	81	(41%)
Product Design	46	(23%)	150	(77%)
Manufacturing process	98	(50%)	99	(50%)
Marketing	99	(51%)	96	(49%)
Office/Secretarial	129	(65%)	68	(35%)
Management	133	(68%)	64	(32%)

3.4.2 Plans for Computer Use

Table 3.27 indicates the areas in which interviewee companies are planning to upgrade existing systems or install new systems within the next five years.

TABLE 3.27

PLANS TO UPGRADE EXISTING SYSTEMS OR INSTALL NEW SYSTEMS

AREA OF OPERATIONS	YES		NO	
Inventory control	145	(74%)	52	(26%)
Product design	84	(43%)	112	(57%)
Manufacturing process	124	(63%)	73	(37%)
Marketing	108	(55%)	88	(45%)
Office/Secretarial	129	(65%)	68	(35%)
Management decision support	133	(68%)	64	(32%)

Table 3.28 indicates the degree to which companies will rely on consulting versus in-house personnel for new systems development.

TABLE 3.28

USE OF CONSULTING VERSUS IN-HOUSE PERSONNEL FOR SYSTEMS DEVELOPMENT

	NO. OF FIRMS	PERCENT
Exclusively consultants	6	3.5
Mostly consultants	32	16.2
Evenly split between the two	49	24.7
Mostly in-house personnel	84	42.4
Exclusively in-house personnel	20	10.1
N/A	7	3.5
	198	100.0

3.4.3 Personnel for Operating Information Systems

Interviewees were asked about the personnel they had for operating their information systems. (See Table 3.28A) Forty-six firms have one or more computer programmers and seventeen had system analysts. Eighteen firms have production and engineering personnel operating computer systems or computerized equipment. Twenty-two firms have managers involved in computer operation including eight with a manager of computer services/data processing/MIS. Twenty firms have a source outside of their Manitoba operations for computer services - either head office personnel or computer service consultants. Sixty-three interviewees mentioned having terminal/keypunch and word processing operators while fifty-four indicated that people in many or all areas had some involvement with the company's information systems.

Only forty-six interviewees gave no response to this question or indicated that they had no personnel responsible for automated information systems. See Appendix D for a categorized summary of the responses.

TABLE 3.28A

PERSONNEL FOR INFORMATION SYSTEMS

Category	No. of firms reporting
Computer programmers	46
Systems analysts	17
Keypunch/data processing	63
Production/engineering	18
Management	22
Other	20
Unspecified	63
None	18
No Response	28

3.5 LINKAGES WITH OTHER INFRASTRUCTURE ELEMENTS

3.5.1 Contribution of Other Organizations to Product/Process Development

Table 3.29 summarizes the assessments of interviewees with respect to the contribution of other groups to a firm's product and process development. In Product Development the majority of companies do not use local or non-local consulting firms (72.7% and 69.7% respectively). Slightly more companies use suppliers (both local and non-local) and trade associations. The greatest use is of customers (only 6.6% not used).

Of the 51 companies which use local consulting firms 37 or 72.5% find them useful or very useful. For the 56 companies which use non-local consulting firms, 48 or 85.7% find them useful or very useful.

Of the 185 firms which use customers, 55.1% find their contributions very useful and 34.8% found them useful.

In Process Development, once again the majority of companies do not use local or non-local consulting firms (72.7% and 65.7% respectively). Customers have much less input on the process side (65.2% do not use them). Suppliers and trade associations remain in the middle range.

Of the 50 companies which do use local consulting firms, 37 or 74% find them useful or very useful. For the 64 companies which use non-local consulting firms 50 or 78.1% find them useful or very useful.

Customers are found to be much less useful (only 19.7% said they were useful, and 7.6% very useful).

TABLE 3.29

CONTRIBUTION OF OTHER ORGANIZATIONS TO PRODUCT DEVELOPMENT AND PROCESS INNOVATION

"Indicate how important the following groups are to you in contributing to both product development and process improvement."

			USED							
	NOT USED		NOT USEFUL		USEFUL		VERY USEFUL		NO RESPONSE	
A. PRODUCT DEVELOPMENT	NO.	%	NO.	%	NO.	%	NO.	%	NO.	%
Customers	13	(6.6%)	4	(2.0%)	69	(34.8%)	109	(55.1%)	3	(1.5%)
Local consulting firms	144	(72.7%)	14	(7.1%)	29	(14.6%)	8	(4.0%)	3	(1.5%)
Non-local consulting firms	138	(69.7%)	8	(4.0%)	43	(21.7%)	5	(2.5%)	4	(2.0%)
Local suppliers	97	(49.0%)	16	(8.1%)	67	(33.8%)	13	(6.6%)	5	(2.5%)
Non-local suppliers	86	(43.4%)	16	(8.1%)	72	(36.4%)	19	(9.6%)	5	(2.5%)
Trade Associations	93	(47.0%)	24	(12.1%)	64	(32.3%)	13	(6.6%)	4	(2.0%)
B. PROCESS DEVELOPMENT										
Customers	129	(65.2%)	10	(5.1%)	39	(19.7%)	15	(7.6%)	5	(2.5%)
Local consulting firms	144	(72.7%)	13	(6.6%)	28	(14.1%)	9	(4.5%)	4	(2.0%)
Non-local consulting firms	130	(65.7%)	14	(7.1%)	36	(18.2%)	14	(7.1%)	4	(2.0%)
Local suppliers	104	(52.5%)	18	(9.1%)	60	(30.3%)	12	(6.1%)	4	(2.0%)
Non-local suppliers	81	(40.9%)	17	(8.6%)	75	(37.9%)	20	(10.1%)	5	(2.5%)
Trade Associations	103	(52.0%)	20	(10.1%)	57	(28.8%)	12	(6.1%)	6	(3.0%)

N = 198

3.5.2 Linkages with Manitoba Universities and Colleges

Table 3.30 summarizes the responses of interviewees on linkages with the education system. 79 or 39.9% of the companies say they do not use either universities or community colleges.

Of the 162 responses, more firms (105 or 64.8%) had links with the university than with community colleges (37 or 22.8%). The majority of contacts with the university dealt with Testing/ Product development (35 or 33.3%) and consulting/discussion (33 or 31.4%). The majority of contacts dealt with Apprenticeship/ Recruiting (17 or 45%) and Committees/Programs (10 or 27%).

The bulk of the comments regarding universities centered around the Engineering faculty (27 or 25.7%) followed by Agriculture (14 or 13.3%) and Science (13 or 12.4%).

TABLE 3.30

LINKAGES WITH UNIVERSITIES AND COLLEGES

INSTITUTION	MENTIONED	TESTING/PRODUCT DEVELOPMENT	CONSULTING/ DISCUSSION	COMMITTEES/ PROGRAMS	APPRENTICESHIP/ RECRUITING	TOTAL
UNIVERSITY OF MANITOBA	3	20	7	5	3	38
Engineering	3	8	8	5	3	27
Science	2	3	5	1	2	13
Admin. Studies	0	0	3	5	0	8
Architecture	0	0	0	1	0	1
Agriculture	1	3	8	1	1	14
Other	0	0	1	1	0	2
BRANDON UNIVERSITY	0	1	1	0	0	2
TOTAL UNIVERSITY	9	35	33	19	9	105
COMMUNITY COLLEGE	0	1	1	1	5	8
RED RIVER	3	5	0	9	12	29
TOTAL COMMUNITY COLLEGES	3	6	1	10	17	37
OTHER	9	5	2	0	4	20
TOTAL NUMBER OF RESPONSES	21	46	36	29	30	162

NONE/NOT USED - 79
NO RESPONSE - 4
n = 198

3.5.3 Assessment of Training at Universities and Colleges

Of the 248 comments regarding the suitability of training 137 or 55.2% were positive while only 70 or 28.2% were negative.

Community colleges received considerably more positive comments (61 or 75.3%) than universities (30 or 46.2%).

Most negative comments about universities were of a general nature (16 or 59.2%).

Only a small percentage (21 or 10.6%) of all respondents said they did not use/hire from the universities or community colleges.

Substantive comments and suggestions on this question are reproduced in Appendix D. 16 companies made comments on the various institutions. The overall feeling was that there is a need for more experience in community college graduates and more practical training for university graduates, especially in the engineering fields.

TABLE 3.31

SUITABILITY OF TRAINING AT UNIVERSITIES AND COLLEGES

INSTITUTION	POSITIVE	NEGATIVE	NEUTRAL	TOTAL	NOT USED	SUGGESTION MADE
UNIVERSITY OF MANITOBA	10	2	2	14		1
Engineering	9	9	3	21		3
Science	2			2		
Admin. Studies	3		3	6		1
Agriculture	4			4		
UNIVERSITIES (General)	2	16		18	2	1
TOTAL UNIVERSITY	30	27	8	65	2	6
RED RIVER COMMUNITY COLLEGE	54	13	3	70		6
COMMUNITY COLLEGES	7	4		11	1	
TOTAL COLLEGES	61	17	3	81	1	6
OVERALL COMMENT	46	26	9	81	18	4
TOTAL	137	70	20	227	21	16

NO RESPONSE - 3
n = 198

3.5.4 Government Programs Used

25 or 12.3% of all respondents said they did not use any government programs. The majority of total programs used were at the federal level (255 or 60.8%), while provincial programs used totalled 84 or 20.0%.

The majority of federal programs used were related to employment such as training programs and wage subsidies (87 or 34.1%) with plant expansion and equipment acquisition programs (eg: DREE/DRIE) running a close second (81 or 31.8%). Research grants were the third most used at 43 or 16.9%. Very few (13 or 5.1%) said that federal programs used were not useful.

The majority of provincial programs used were related to employment such as the Jobs Fund and Career Start (27 or 32.1 %) with programs under the Manitoba Research Council's Industrial Technology Centre second (20 or 23.8%). The Department of Industry, Trade and Technology was the third most used (12 or 14.3%). Only 6 or 7.1% said the programs were not useful, but 5 of those referred only to Manitoba programs in general.

Eleven companies made comments on the government programs they used. The majority of these related to programs in general (6). These were usually of a negative nature, complaining mostly about the paperwork or the trouble in trying to qualify for programs. Other comments related to DREE and PEMD, with suggestions for improving the programs.

Substantive comments are found in Appendix D.

TABLE 3.32

FEDERAL/PROVINCIAL PROGRAMS USED

PROGRAM	MENTIONED	USEFUL	NOT USEFUL	TOTAL	COMMENTS/ SUGGESTIONS
FEDERAL	11	2		13	
MANPOWER	14	11	2		
- Job Creation	1	2			
- UIC Workshare	6	8	1		
- Training/Apprentice	21	13	3		
- Wage Subsidies	3	2			
TOTAL MANPOWER	45	36	6	87	
RESEARCH - IRAP	13	7	1		
- IERD	1				
- NRC	13	8			
TOTAL RESEARCH	27	15	1	43	
PLANT EXPANSION/EQUIPMENT	3	2			
- DREE/DRIE	50	21	3		2
- IRDP	2				1
TOTAL PLANT EXPANSION/EQUIPMENT	55	23	3	81	3
MARKETING	3	2	1		1
- PEMD	7	9	1		1
TOTAL MARKETING	10	11	2	23	2
FBDB/CASE	1	5	1	7	1
EDC		1		1	
TOTAL FEDERAL PROGRAMS	149	93	13	255	6

TABLE 3.32 (con't)

FEDERAL/PROVINCIAL PROGRAMS USED

PROGRAM	MENTIONED	USEFUL	NOT USEFUL	TOTAL	COMMENTS/ SUGGESTIONS
MANITOBA	5	3	5	13	
- Job Creation	1	2			
- Jobs Fund	5	2			
- Students	4	4			
- Career Start	5	1			
- Apprentice	3				
TOTAL JOB-RELATED	18	9		27	
INDUSTRY, TRADE & TECHNOLOGY	7	5		12	
BUSINESS DEVELOPMENT	1				
- Venture Capital	2				
TOTAL BUSINESS DEVELOPMENT	3			3	
ITC	12	7	1	20	
MBA CONSULTANTS	1	1		2	
CFPDC	5	2		7	
TOTAL PROVINCIAL PROGRAMS	51	27	6	84	
OTHER	51	23	6	80	6
TOTAL PROGRAMS USED	251	143	25	419	12

NOT USED - 25
PROVINCE - NOT USED - 4
NO RESPONSE - 4

3.5.5 Suggested Government Programs

The greatest favorable responses (continue or enhance) regarding government programs related to jobs/training (18 or 30%) and specific grant programs (16 or 26.7%) (See Table 3.33).

Of the total 90 responses, 39 or 33.3% involved eliminating programs or policies. Of these 30, the majority related to government regulation/involvement (11 or 36.7%) and taxes (13 or 43.3%).

Appendix D contains a detailed listing of comments and suggestions with respect to programs and policies the interviewees would like to see from government. This particular section elicited the greatest response from the companies surveyed (96 firms, 109 comments), in regards to suggestions for new programs. The majority of these (35) related to specific grant programs that would help the company or industry in question. 22 comments centered on training in jobs to either make existing training more appropriate or to begin training in more specialized fields. The remaining comments deal mostly with assistance in upgrading plant and equipment and more financial backing for R & D (product development).

TABLE 3.33

GOVERNMENT PROGRAMS FIRMS WOULD LIKE TO SEE

PROGRAMS	MENTIONED/ CONTINUE	ENHANCE	TOTAL	REDUCE/ ELIMINATE	COMMENTS SUGGESTIONS
JOBS/TRAINING	7	11	18	1	22
GOVERNMENT REGULATION/ INVOLVEMENT				11	
TAXES		2	2	13	9
INCENTIVES/SUBSIDIES		3	3		4
SPECIFIC GRANT PROGRAMS	9	7	16		35
OTHER PROGRAMS	3	4	7		17
SPECIFIC DEPARTMENTS	2	3	5		5
OTHER - Labour law, spending	4	5	9	5	17
TOTAL	25	35	60	30	109

WHAT WE HAVE NOW IS ALRIGHT - 9
NONE/DON'T KNOW - 19
NO RESPONSE - 11

3.5.6 Inhibitors of Technological Change

Table 3.34 categorizes the responses of interviewees to the question of technological change.

Of a total of 233 responses, 41.6% said finances/cost/money was the greatest inhibitor of technological innovation. The particular market characteristics facing the firms was the second greatest inhibitor (12.4%).

Comments substantively different from those summarized in Table 3.34 are in Appendix D. These comments involve specific setbacks the companies found most troublesome. Most relate to government involvement or policies (9 out of 21 comments).

TABLE 3.34

WHAT INHIBITS ADOPTION OF TECHNOLOGICAL INNOVATION

	NUMBER OF RESPONSES		SPECIFIC PROBLEM MENTIONED
Company's Lack of Expertise	16	(6.9%)	2
Market Size/Demand/Maturity	29	(12.4%)	
Economy/Market Uncertainty	11	(4.7%)	
Government	4	(1.7%)	9
Finances/Cost/Money	97	(41.6%)	3
Risk/ROI/Time to Recoup Investment	17	(7.3%)	1
Other*	32	(13.8%)	6
Nothing/No	23	(9.9%)	
No Response	4	(1.7%)	
TOTAL	233	100.0%	21

* Other includes: obsolescence, geographical location, lack of information, size of company, education, unions, future of industry, food regulations, noise levels, foreign currency exchange, lack of supplies, resistance to change, product mix, economies of scale, loss of workload, innovate too quickly.

4. ASSESSMENT OF MANITOBA TECHNOLOGICAL INFRASTRUCTURE

4.1 Introduction

The primary function of this report is to assemble a set of baseline data on the most technologically innovative industrial firms in Manitoba. Ultimately these data will be compared with subsequent collections of data to determine the change, or improvement in the technological infrastructure. It will also be desirable to determine whether the proactive policies of the Manitoba and Canadian governments have had a positive effect on any subsequent improvement in the Manitoba technological infrastructure and in the level of technological activity in Manitoba.

It is possible, however, to make some comments about the current technological infrastructure in Manitoba based upon the data now available. This can be done in three ways:

a) Comparison of Manitoba data to other available data.

b) Examination of Manitoba results in comparison to factors desirable in a technological infrastructure.

c) Examination of answers to certain evaluative questions in the survey.

4.2 Comparison of Manitoba to Others.

Some very limited comparisons of the Manitoba data to material from other sources is possible.

4.2.1 Number of Research and Development Units in Manitoba

It was reported by Statistics Canada that Manitoba had 47 research and development units. The current survey indicated 43 firms with R & D expenditures in excess of $200,000. This did not include a limited number of larger companies (less than 10) that did not respond.

This number of firms undertaking a fairly significant level of R & D expenditure is far from the level of industrial R & D units reported for some other provinces.

eg: Ontario - 814 units
Quebec - 321 units
British Columbia - 136 units
Alberta - 115 units

4.2.2 Comparison to Economic Council of Canada Study of the Manufacturing Sector in Manitoba.

Although the Economic Council study focused only on the transportation and clothing sectors there were similarities observed between their findings and the results of this data collection exercise.

These included:

a) Sales distribution by region is similar i.e., both indicated a large proportion of company sales were outside Manitoba. Other Western Canadian provinces were the most important market outside Manitoba in both studies.

1 Statistics Canada, Industrial R & D Units by Industry Group and Region, 1982, (Ottawa: Science and Technology Statistics Division, Statistics Canada).

2 N. E. Cameron, J. M. Dean and W. S. Good, The Manufacturing Sector in Manitoba, Discussion Paper No. 254, (Ottawa: Economic Council of Canada, 1984).

The export orientation of the leading firms interviewed in this study was somewhat greater than the export orientation for the census of firms studied in the transportation and clothing industries.

b) The clothing and transportation census study showed a greater proportion of smaller firms than this survey of leading firms, ie: 43 percent of firms in their study were under 25 employees versus only 27 percent in this study.

They had 32 percent in the 25-49 employee category while this survey had only 18 percent of respondents with 25 - 49 employees.

c) Both studies asked respondents to comment on whether they see themselves more or less technologically advanced than their industry as a whole. Comparing the results for production technologies, the current survey indicates that these leading firms see themselves as about the same as the census of clothing and transportation firms.

TABLE 1

HEAD OFFICE BY SALES

Crosstabulation: V05 SALES By V04 HEAD OFFICE

V05	Count / Row Pct / Col Pct / Tot Pct	V04 1.00 MR	V04 2.00 CDA	V04 3.00 US	V04 4.00 OTHER	Row Total
0.0		3	2	1		6
NA		50.0	33.3	16.7	.	3.0
		2.1	5.3	7.1		
		1.5	1.0	.5		
1.00		20	3	3		26
.5M		83.3	8.3	9.3		13.1
		13.8	5.7	14.3		
		10.1	1.5	1.5		
2.00		17	1			18
.5-.9M		94.4	5.6			9.1
		11.7	2.6			
		8.6	.5			
3.00		16	1	1		18
1-1.9M		88.9	5.6	5.6		9.1
		11.0	2.6	7.1		
		8.1	.5	.5		
4.00		24	4	2		30
2-4.9M		80.0	13.3	6.7	.	15.2
		16.6	10.5	14.3		
		12.1	2.0	1.0		
5.00		24	5	1		30
5-9.9M		80.0	16.7	3.3		15.2
		16.6	13.2	7.1		
		12.1	2.5	.5		
6.00		16	7	2		25
10-19.9M		64.0	28.0	8.0		12.6
		11.0	18.4	14.3		
		8.1	3.5	1.0		
7.00		17	6	1		24
20-49.9M		70.8	25.0	4.2		12.1
		11.7	15.8	7.1		
		8.6	3.0	.5		
8.00			2	3		5
50-99.9			40.0	60.0		2.5
			5.3	21.4		
			1.0	1.5		
9.00		4	4			8
100-500M		50.0	50.0			4.0
		2.8	10.5			
		2.0	2.0			
10.00			1			1
>500			100.0			.5
			2.6			
			.5			
11.00		4	2	1	1	8
REF		50.0	25.0	12.5	12.5	4.0
		2.8	5.3	7.1	100.0	
		2.0	1.0	.5	.5	
	Column Total	145	38	14	1	198
		73.2	19.2	7.1	.5	100.0

Number of Missing Observations = 0

TABLE 2

Head Office by How Advanced Product Technology (Outside Canada)

Crosstabulation: V04 HEAD OFFICE By V42 PROD TECH ADV-OUTSIDE

V04 / V42->	Count / Row Pct / Col Pct / Tot Pct	NA 0.0	MORE ADV/BALANCED 1.00	SAME 2.00	LESS ADV/BALANCED 3.00	4.00	Row Total
1.00	Count	3	39	73	18	12	145
MB	Row Pct	2.1	26.9	50.3	12.4	8.3	73.2
	Col Pct	75.0	68.4	72.3	75.0	100.0	
	Tot Pct	1.5	19.7	36.9	9.1	6.1	
2.00	Count		14	20	4		38
CDA	Row Pct		36.8	52.6	10.5		19.2
	Col Pct		24.6	19.8	16.7		
	Tot Pct		7.1	10.1	2.0		
3.00	Count	1	4	7	2		14
US	Row Pct	7.1	28.6	50.0	14.3		7.1
	Col Pct	25.0	7.0	6.9	8.3		
	Tot Pct	.5	2.0	3.5	1.0		
4.00	Count			1	1		1
OTHR	Row Pct			100.0			.5
	Col Pct			1.0			
	Tot Pct			.5			
	Column Total	4 2.0	57 28.8	101 51.0	24 12.1	12 6.1	198 100.0

Number of Missing Observations = 0

TABLE 3

Sales by How Advanced Product Technology (Outside Canada)

Crosstabulation: V05 SALES By V42 PROD TECH ADV-OUTSIDE

V05	Count / Row Pct / Col Pct / Tot Pct	NA (0.0)	MORE ADVANCED (1.00)	SAME (2.00)	LESS ADVANCED (3.00)	(4.00)	Row Total
0.0			2	3	1		6
NA			33.3	50.0	16.7		3.0
			7.4	2.9	4.2		
			1.0	1.5	.5		
1.00		1	11	9	1	2	24
.5M		4.2	45.8	37.5	4.2	8.3	12.1
		25.0	19.3	8.8	4.2	16.7	
		.5	5.6	4.5	.5	1.0	
2.00		1	3	9	3	2	18
.5-.9M		5.6	16.7	50.0	16.7	11.1	9.1
		25.0	5.3	8.9	12.5	16.7	
		.5	1.5	4.5	1.5	1.0	
3.00		1	4	12		1	18
1-1.9M		5.6	22.2	66.7		5.6	9.1
		25.0	7.0	11.8		8.3	
		.5	2.0	6.1		.5	
4.00			6	20	6	1	33
2-4.9M			18.2	60.6	18.2	3.0	16.7
			10.5	19.8	25.0	8.3	
			3.0	10.1	3.0	.5	
5.00			3	10	4	3	20
5-7.9M			15.0	50.0	20.0	15.0	10.1
			15.8	17.8	16.7	16.7	
			1.5	5.1	2.0	1.5	
6.00			6	9	2	2	22
10-19.9M			27.3	40.9	9.1	22.7	11.6
			15.8	8.9	8.3	33.3	
			3.0	4.5	1.0	1.0	
7.00			10	11	3		24
20-49.9M			41.7	45.8	12.5		12.1
			26.3	10.9	12.5		
			5.1	5.6	1.5		
8.00				4	1		5
50-99.9				80.0	20.0		2.5
				3.9	4.2		
				2.0	.5		
9.00		1	1	4	2		8
100-500M		12.5	12.5	50.0	25.0		4.0
		25.0	2.6	3.9	8.3		
		.5	.5	2.0	1.0		
10.00			1				1
>500			100.0				.5
			2.6				
			.5				
11.00			3	1	2	1	7
NFS			42.9	14.3	28.6	14.3	3.5
			7.9	1.0	8.3	8.3	
			1.5	.5	1.0	.5	
	Column Total	4 2.0	38 19.2	101 51.0	24 12.1	12 6.1	198 100.0

Number of Missing Observations = 0

TABLF 4

Research & Development by How Advanced is Product Technology (Outside Canada)

Crosstabulation: V42 PROD TECH ADV-OUTSIDE By V11 R&D-($000)

V42	V11->	NA 0.0	<50 1.00	50-99 2.00	100-199 3.00	200-299 4.00	300-399 5.00	400-499 6.00	500+ 7.00	REF 8.00	Row Total
0.0	Count	2	1		1						4
NA	Row Pct	50.0	25.0		25.0						2.0
	Col Pct	4.1	1.6		3.6						
	Tot Pct	1.0	.5		.5						
1.00	Count	10	14	4	12	6	4	3	3	1	57
MORE ADVANCED	Row Pct	17.5	24.6	7.0	21.1	10.5	7.0	5.3	5.3	1.8	28.8
	Col Pct	20.4	22.6	28.6	42.9	42.9	50.0	50.0	20.0	50.0	
	Tot Pct	5.1	7.1	2.0	6.1	3.0	2.0	1.5	1.5	.5	
2.00	Count	29	32	9	8	7	4	2	9	1	101
SAME	Row Pct	28.7	31.7	8.9	7.9	6.9	4.0	2.0	8.9	1.0	51.0
	Col Pct	59.2	51.6	64.3	28.6	50.0	50.0	33.3	60.0	50.0	
	Tot Pct	14.6	16.2	4.5	4.0	3.5	2.0	1.0	4.5	.5	
3.00	Count	4	9	1	5	1		1	3		24
LESS ADVANCED	Row Pct	16.7	37.5	4.2	20.8	4.2		4.2	12.5		12.1
	Col Pct	8.2	14.5	7.1	17.9	7.1		16.7	20.0		
	Tot Pct	2.0	4.5	.5	2.5	.5		.5	1.5		
4.00	Count	4	6		2						12
DK	Row Pct	33.3	50.0		16.7						6.1
	Col Pct	8.2	9.7		7.1						
	Tot Pct	2.0	3.0		1.0						
	Column Total	49 24.7	62 31.3	14 7.1	28 14.1	14 7.1	8 4.0	6 3.0	15 7.6	2 1.0	198 100.0

Number of Missing Observations = 0

TABLE 5

Industry by How Advanced is Product Technology (Outside Canada)

Crosstabulation: V03 INDUSTRY By V42 PROD TECH ADV-OUTSIDE

V42-> / V03	Count / Row Pct / Col Pct / Tot Pct	0.00	1.00 MORE ADVANCED	2.00 SAME	3.00 LESS ADVANCED	4.00	Row Total
1.00 CHEM			6	18	3	1	28
			21.4	64.3	10.7	3.6	14.1
			10.5	17.8	12.5	8.3	
			3.0	9.1	1.5	.5	
2.00 WOOD			1	8	7	1	17
			5.9	47.1	41.2	5.9	8.6
			1.8	7.9	29.2	8.3	
			.5	4.0	3.5	.5	
3.00 METAL			6	21	2	3	32
			18.8	65.6	8.3	9.4	16.1
			10.5	20.8	8.3	25.0	
			3.0	10.6	1.0	1.5	
4.00 MACH		2	11	18	6	2	39
		5.1	28.2	46.2	15.4	5.1	19.7
		50.0	19.3	17.8	25.0	16.7	
		1.0	5.6	9.1	3.0	1.0	
5.00 ELECTRICAL		1	15	15	4	3	38
		2.6	39.5	39.5	10.5	7.9	19.2
		25.0	26.3	14.9	16.7	25.0	
		.5	7.6	7.6	2.0	1.5	
6.00 FOOD			10	12	1		23
			43.5	52.2	4.3		11.6
			17.5	11.9	4.2		
			5.1	6.1	.5		
7.00 OTHER			2	6	1	2	11
			18.2	54.5	9.1	18.2	5.6
			3.5	5.9	4.2	16.7	
			1.0	3.0	.5	1.0	
8.00 NONMFG-OTHER		1	4	3			8
		12.5	50.0	37.5			4.0
		25.0	7.0	3.0			
		.5	2.0	1.5			
Column Total		4	57	101	24	12	198
		2.0	28.8	51.0	12.1	6.1	100.0

Number of Missing Observations = 0

TABLE 6

Source of Technical Expertise-Product by Head Office

Crosstabulation: V04 HEAD OFFICE By V44 EXPERT1-PROD

V04	Count / Row Pct / Col Pct / Tot Pct	NA 0.0	IN ORG IN MB 1.00	IN ORG OT MB 2.00	NOT ORG IN MB 3.00	NOT ORG NOT MB 4.00	Row Total
MB	1.00	7	100	3	10	25	145
		4.8	69.0	2.1	6.9	17.2	73.2
		87.5	82.6	12.5	90.9	73.5	
		3.5	50.5	1.5	5.1	12.6	
CDA	2.00	1	12	17	1	7	38
		2.6	31.6	44.7	2.6	18.4	19.2
		12.5	9.9	70.8	9.1	20.6	
		.5	6.1	8.6	.5	3.5	
US	3.00		8	4		2	14
			57.1	28.6		14.3	7.1
			6.6	16.7		5.9	
			4.0	2.0		1.0	
OTHER	4.00		1				1
			100.0				.5
			.8				
			.5				
	Column Total	8 4.0	121 61.1	24 12.1	11 5.6	34 17.2	198 100.0

Number of Missing Observations = 0

TABLE 7

Source of Technical Expertise-Product by Sales

Crosstabulation: V05 SALES By V44 EXPERTI-PROD

V05 \ V44->	NA 0.0	IN ORG IN MB 1.00	IN ORG NOT MB 2.00	NOT ORG IN MB 3.00	NOT ORG NOT MB 4.00	Row Total
0.0 NA		3 50.0 2.5 1.5	2 33.3 8.3 1.0		1 16.7 2.9 .5	6 3.0
1.00 <.5M	1 4.2 12.5 .5	15 62.5 12.4 7.6	3 12.5 12.5 1.5	2 8.3 18.2 1.0	3 12.5 8.8 1.5	24 12.1
2.00 .5-.9M	3 16.7 37.5 1.5	12 66.7 9.9 6.1		3 16.7 27.3 1.5		18 9.1
3.00 1-1.9M	1 5.6 12.5 .5	12 66.7 9.9 6.1	3 16.7 12.5 1.5		2 11.1 5.9 1.0	18 9.1
4.00 2-4.9M		23 71.9 19.0 11.6	3 9.4 12.5 1.5	1 3.1 9.1 .5	5 15.6 14.7 2.5	32 16.2
5.00 5-9.9M	1 2.2 12.5 .5	18 58.1 14.9 9.1	4 12.9 16.7 2.0	2 6.5 18.2 1.0	6 19.4 17.6 3.0	31 15.7
6.00 10-19.9M		11 47.8 9.1 5.6	1 4.3 4.2 .5	1 4.3 9.1 .5	10 43.5 29.4 5.1	23 11.6
7.00 20-49.9M		13 54.2 10.7 6.6	4 16.7 16.7 2.0	1 4.2 9.1 .5	6 25.0 17.6 3.0	24 12.1
8.00 50-99.9	1 20.0 12.5 .5	3 60.0 2.5 1.5	1 20.0 4.2 .5			5 2.5
9.00 100-500M	1 12.5 12.5 .5	4 50.0 3.3 2.0	1 12.5 4.2 .5	1 12.5 9.1 .5	1 12.5 2.9 .5	8 4.0
10.00 >500			1 100.0 4.2 .5			1 .5
11.00 PEF		7 87.5 5.8 3.5	1 12.5 4.2 .5			8 4.0
Column Total	8 4.0	121 61.1	24 12.1	11 5.6	34 17.2	198 100.0

Number of Missing Observations = 0

The last entry in each cell for which there is at least one observation is the total percentage (TOT PCT). The number of cases in the cell is expressed as a percentage of the total number of cases in the table. For example, the 3 firms not reporting sales and having Manitoba head offices represent 1.5% of all firms.

The numbers to the right and below the table are known as marginals. They are the counts and percentages for the row and column variables taken separately. In Table 1, the column marginals show that 145 firms (73.2%) had head offices in Manitoba, 38 firms (19.2%) had them elsewhere in Canada, 14 firms (7.1%) had them in the U.S. and one had its head office outside Canada and the U.S.

4.2.3 Comparison to 1984 Ontario Technology Centre Study.

The Ontario study asked their 623 interviewees if they had implemented certain advanced technological systems. The Manitoba study asked if firms had certain types of advanced equipment and systems related to product and processing activities. Comparative results are indicated below (Table 4.1).

TABLE 4.1

SELECTED COMPARISON OF MANITOBA AND ONTARIO ADVANCED SYSTEMS IMPLEMENTED BY RESPONDENTS

	Manitoba (%)	Ontario (%)
Computer Aided Design	15	9
Computer Aided Manufacturing	18	21
Robots	4	5

These figures must be regarded with some caution. The Ontario study was conducted by telephone as opposed to in-person. The Manitoba numbers for computer aided design and manufacturing include a number of smaller scale systems that handle limited jobs or parts of larger jobs. We are not certain how these terms were defined for the Ontario telephone survey.

3 A Study Among Ontario Manufacturers in Regards to the Introduction of Advanced Technology and the Ontario Technology Centres, (Toronto: Foster Research Services, 1984).

4.3 Assessment Relative to Criteria Developed From Technological Infrastructure Review.

There are certain characteristics normally associated with locations conducive to rapid economic growth as a result of technological activity.

These include things such as:

a) Strong science-based industry sectors.

b) Strong research (science and engineering) universities with links to the industrial sector.

c) Depth in individual industry sectors.

d) Depth in individual industry support services (including suppliers).

e) Access to financial resources.

f) Attractive market conditions and/or market access.

g) Skilled labour force.

In the following sections we will look at how the Manitoba situation appears in relation to these criteria.

4.3.1 Strong Science-Based Industry

It cannot be concluded that Manitoba has a strong science-based set of firms in science-based industries. Major industries tend to be technology using, rather than technology developing. eg: process technology in the clothing industry. The major industry sectors included in the 200 interviews (clothing and food processing) are not normally regarded as science-based industries.

Others such as electronics and health related (which are often associated with strong science-based industry) tend to be smaller firms.

4.3.2 Strong Research Universities With Ties to the Industrial Sector

There is evidence that Manitoba universities - particularly the University of Manitoba - are quite active in research. In 1983 - 84 the university was sixth highest in Canada in level of research funding.

On the other hand, there is quite a low level of interaction between the universities and the 200 industrial firms interviewed. Forty percent of the firms had no interaction with the University. The greatest number of contacts were indicated to be with engineering (27).

The linkages to the university do not appear to be very strong. Much of the interaction is in terms of committee membership and ongoing casual discussion. There is little evidence of widespread efforts by firms to avail themselves of the expertise, such as it is, of faculty members on a case by case basis.

4.3.3 Depth in Individual Industry Sectors.

The situation in Manitoba definitely appears to be that there is not a great deal of depth in most industry sectors. Table 3.1 illustrates this situation vividly.

There are very few firms classified as technologically innovative in most sectors. Food processing (25), electronics (23), metal-working (18), plastics (13), clothing (11) and printing (11) are the most concentrated areas.

Many classifications have only one or two (certainly 5 or fewer) firms. Another indication of lack of depth is that during interviews, when respondents were asked who they viewed as the leading firms in their industries in Manitoba, many did not respond and indicated instead that their industry competition came from outside, not inside Manitoba.

4.3.4 Depth in Industry Support (Including Suppliers)

The general conclusion is that Manitoba firms lack support in most industries.

Evidence pointing to this includes:

- When firms were asked where they got expertise for product development, the category outside the organization, but in Manitoba ranked fourth out of four.

- When firms were asked where they got expertise for process development the category outside the organization, but in Manitoba ranked fourth out of four.

- When asked about usefulness of local consultants for product devleopment, 70 percent of respondents do not use them. Of those who use local consultants 1 out of 3 say they are useful.

- When asked about usefulness of local consultants for process development, 73 percent of respondents do not use them. Of those who do use local consultants 1 of 3 say they are not useful.

- When asked about usefulness of local suppliers (including regional offices of nationals) for product develpment, 50 percent of respndents do not use them. (Slightly more companies use out of province suppliers.) Only 1 in 6 who use them say they are not useful.

- When asked about usefulness of local suppliers for process development 53 percent do not use them. (Only 41 percent do not use out of province suppliers.) Only 1 in 5 who use them say they are not useful.

- A number of comments made during interviews indicated probblems with local suppliers who are regional suppliers of national firms.

- The government sponsored research agencies are, in the main, not related to Manitoba industry. ie: Much health care and agricultural. Only the Industrial Technology Centre, the CFPDC, the Microelectronics Centre and HVDC are set up to address industry needs.

4.3.5 Access to Financial Services

A number of respondents (almost 50 percent) when asked what inhibited them from adopting technological innovations indicated either cost/finances or money. This was the dominant response. Market size was next (14.5 percent).

We do not feel, however, that this should necessarily be taken as indicative of problems with the financial system in the province.

4.3.6 Attractive Market Conditions and/or Market Access

The major evidence that this is a problem is that 15.0 percent of firms interviewed suggested that market size or demand were factors inhibiting technological adoptions.

There is obviously not a market of major size in Manitoba. Only 30 percent of companies interviewed sold more than 50 percent of their output in Manitoba.

This is probably a factor inhibiting development of the Manitoba technological infrastructure.

4.4 Implications.

Certain implications for further development of the Manitoba technological infrastructure are suggested. These include:

4.4.1 Larger Manitoba firms should encourage and support development of smaller local firms as suppliers to them.
One of the major weaknesses in the technological infrastructure was local suppliers. Small local firms cannot effectively encourage development of these, but larger local firms can. This should be encouraged.

4.4.2 Attempt to attract other larger firms and organizations to establish in Manitoba, and support the development of local supply firms as part of the technological infrastructure.

4.4.3 Do not have government encourage the establishment of directly competitive firms.

4.4.4 Encourage the identification of market opportunity for Manitoba manufacturers. Have the Governments of Manitoba and Canada source more products from local suppliers.

4.4.5 Encourage more linkages between Manitoba firms and the various capabilities of the University of Manitoba.

4.4.6 Foster small firm start-ups for people identified as very talented be they graduate students, employees of other firms, teachers, government employees, etc.

4.4.7 Do all that is possible to help larger firms develop. At the same time focus on 15 - 40 smaller firms and develop specific programs to directly, or indirectly, ensure that these firms have as much support as possible to help them deal with problems of their start-up and growth.

APPENDIX A

QUESTIONNAIRE FORMAT

MANITOBA DEPARTMENT OF INDUSTRY,
TRADE AND TECHNOLOGY/
GOVERNMENT OF CANADA

TECHNOLOGY AUDIT QUESTIONNAIRE

FINAL DRAFT

Job No. 0019-001

Prepared for:

MANITOBA DEPARTMENT OF INDUSTRY,
TRADE AND TECHNOLOGY/
GOVERNMENT OF CANADA

Prepared by:

WESTERN OPINION RESEARCH, INC.
711 - 213 Notre Dame Avenue
Winnipeg, Manitoba
R3B 1N3

January 30, 1985

Survey # _____(1)

Interviewer: _____ Date: _____(2)

This interview is part of a technology audit being conducted by Western Opinion Research, Inc. on behalf of the governments of Manitoba and Canada. The information gathered from the 200 firms being interviewed will be used to help formulate government policy and programs with respect to the manufacturing sector of this province.

The specific information obtained in this interview will be kept confidential and will be restricted to use by Manitoba Industry, Trade and Technology, the Manitoba Research Council and at the federal level, the Ministry of State for Regional Development and the Department of Regional Industrial Expansion. While firm-specific information will be kept confidential, aggregated data will be made available to participating firms and other organizations upon request.

There are fives sections to the interview:

(i) a demographic section to establish what type of firm you are in terms of size, affiliation, nature of your operations;

(ii) a section on products and product development;

(iii) a section on your production process;

(iv) a section on information systems you use in your operation, and

(v) a section on linkages you have with other firms and agencies, including your assessment of current government programs.

I. DEMOGRAPHICS

1.0 Firm _____

1.1 Industry _____(3)

1.2 Interviewee _____

1.3 Position _____

2.0 Head Office:
1 Manitoba
2 Canada, outside Manitoba (4)
3 United States
4 Outside Canada and U.S.

3.0 What types of products does your firm sell? What percentage of sales does each of these represent?

_____ ____%

_____ ____%

_____ ____%

_____ ____%

_____ ____%

_____ ____%

_____ ____%

4.0 1984 Sales of products produced in Manitoba (millions of dollars)

< 500,000	____	
500,000 - 1 M	____	
1 M - 2 M	____	
2 M - 5 M	____	
5 M - 10 M	____	
10 M - 20 M	____	(5)
20 M - 50 M	____	
50 M - 100 M	____	
100 M - 500 M	____	
> 500 M	____	

4.1 What percent of your total sales are made:

In Manitoba	____%	(6)
In the other western provinces	____%	(7)
In Eastern Canada	____%	(8)
In the United States	____%	(9)
Outside of Canada and the U.S.	____%	(10)
Total	100%	

5.0 Approximately how much would you spend annually on research and development in your organization in Manitoba?

$_____(11)

5.1 What proportion is in research _____% (12)
versus development _____% (13)

5.2 What proportion of this expenditure is devoted
to product development _____% (14)
to process innovation _____% (15)

5.3 In the R & D estimate you just gave what is the relative size of the following components? (ie: What do you include in your estimate?)

wages of full time employees	_____%	(16)
equipment acquisition	_____%	(17)
materials	_____%	(18)
outside fees and salaries	_____%	(19)
facilities expenditures	_____%	(20)

6.0 Total employees in Manitoba operations _____(21)
(as of day of interview)

<u>Professional Engineers</u>

Estimated number of electrical	_____	(22)
Estimated number of mechanical (industrial)	_____	(23)
Estimated number in other fields of specialization	_____	(24)
list: _____		(25)
_____		
Total Engineers	_____	(26)

<u>Scientists</u>

list: _____	# _____	(27)
_____	# _____	(28)
_____	# _____	(29)
Total Scientists	_____	(30)

<u>Other Employee Categories</u>

Computer Specialists	_____	(31)
Technologists	_____	(32)
Technicians	_____	(33)
Managers	_____	(34)
Production	_____	(35)
Marketing	_____	(36)
Administrative/ office and other	_____	(37)

II PRODUCTS

For the following section we ask that you focus on the nature of the product(s) that you produce as opposed to the manufacturing process. Following this section on products, there will be a section asking questions about your production process.

1.0 What would you describe as the most important technological disciplines involved in the composition of your major products?

1st_____(38) 2nd_____(39) 3rd_____(40)

Code:
- 01 Electrical
- 02 Electronics
- 03 Mechanical and Industrial Engineering
- 04 Design/Packaging
- 05 Chemical
- 06 Materials
- 07 Biotechnology
- 08 Food Science
- 09 Communication/Information Processing
- 10 Energy/Energy Conservation
- 11 Nuclear
- 12 Other (specify) _____

Describe: _____

_____

_____

2.0 Overall, how technologically advanced would you say your major products are compared to other manufacturers of similar products in Canada?

Circle One
- 1 More advanced
- 2 Same (41)
- 3 Less advanced
- 4 Don't know

2.1 Overall, how technologically advanced would you say your major products are compared to other manufacturers of similar products in the rest of the world? (eg: North America, Europe, Japan, etc.)

Circle One
- 1 More advanced
- 2 Same (42)
- 3 Less advanced
- 4 Don't know

3.0 In the past five years, how active has your company been in introducing technological improvements to your major products?

Circle One
- 1 Very active
- 2 Somewhat active (43)
- 3 Not active

3.1 From where does your company usually get the technical expertise necessary to make product improvements? Please indicate the most important source, and the second and third most important sources if they are applicable.

1st_____(44) 2nd_____(45) 3rd_____(46)

Code:
- 1 - Within your organization in Manitoba?
- 2 - Within your organization outside Manitoba?
- 3 - Outside your organization but in Manitoba?
- 4 - Outside your organization and outside Manitoba?

3.2 Where are the decisions made regarding what product development will be undertaken in your organization in Manitoba?

1 - Here in Manitoba
2 - Outside Manitoba (47)

4.0 In your industry, how strong is the pressure for product innovation?

1 Strong
2 Neutral (48)
3 Weak

4.1 What product innovations do you think will occur in your industry in the next 5 years?

_____

_____

_____

_____

5.0 How many staff years do you devote annually to product development in your Manitoba operations?

_____ (49)

5.1 In which of the following technological areas do these people have an expertise?

_____(50) _____(51)

Code:
01 Electrical
02 Electronics
03 Mechanical and Industrial Engineering
04 Design/Packaging
05 Chemical
06 Materials
07 Biotechnology
08 Food Science
09 Communication/Information Processing
10 Energy/Energy Conservation
11 Nuclear
12 Other (specify) _____

5.2 Who are the individuals who make the greatest contribution to product development?

i) in your company? (names and/or position if possible

_____

_____

ii) in other organizations in Manitoba?

_____

_____

_____

5.3 Can you identify the most technologically innovative companies in this industry in Manitoba regarding product development?

_____

_____

_____

_____

6.0 What special or unique capabilities, facilities or equipment do you have in Manitoba for product development and for product testing?

Describe facilities, _____

_____

_____

Listing of unique equipment related to these facilities:

_____

_____

_____

_____

_____

Specifically, do you have computer-aided design? (CAD)

Yes____ (52)

No ____

Do you have computer-aided engineering (CAE)

Yes____ (53)

No_____

7.0 In the next five years what are your intentions with respect to product development? What direction will you be going in this area?

_____

_____

_____

_____

7.1 If you plan to hire more people for product development, what would their backgrounds be? How many?

_____

_____

III MANUFACTURING PROCESS

In the last section, I asked you about product and product development. In the next section I would like you to focus on the production process that you use to manufacture your product.

1.0 In the manufacture of your major product, what are the key technological ingredients of the production system at the following steps:

	1st	2nd	3rd
Materials Handling/Production Scheduling	(54)	(55)	(56)
Assembly/Processing	(57)	(58)	(59)
Testing	(60)	(61)	(62)

Code:
01 Electrical
02 Electronics
03 Mechanical and Industrial Engineering
04 Design/Packaging
05 Chemical
06 Materials
07 Biotechnology
08 Food Science
09 Communication/Information Processing
10 Energy/Energy Conservation
11 Nuclear
12 Other (specify) _____

2.0 Overall, how technologically advanced would you say your production system is compared to other manufacturers of similar products in Canada?

1 More advanced
2 Same
3 Less advanced (63)
4 Don't know

2.1 Overall, how technologically advanced would you say your production system is compared to other manufacturers of similar products in the rest of the world?

1 More advanced
2 Same
3 Less advanced (64)
4 Don't know

3.0 In the past five years, how active has your company been in introducing technological improvements to your production process?

1 Very active
2 Somewhat active (65)
3 Not active

3.1 From where does your company usually get the technical expertise necessary to improve the production process? Please indicate the most important source, and the second and third most important sources if they are applicable.

1st_____(66) 2nd_____(67) 3rd_____(68)

Code: 1 - Within your organization in Manitoba?
2 - Within your organization outside Manitoba?
3 - Outside your organization but in Manitoba?
4 - Outside your organization and outside Manitoba?

3.2 Where are the decisions about what process improvements will be undertaken in your organization in Manitoba?

1 - Here in Manitoba
2 - Outside Manitoba (69)

4.0 In your industry, how strong is the pressure to improve the production process?

1 Strong
2 Neutral (70)
3 Weak

4.1 What process innovations do you think will occur in your industry in the next 5 years?

_____

_____

_____

_____

5.0 How many staff years do you devote locally to improvements in the production process?

_____ (71)

5.1 In which of the following technological areas do these people have an expertise (if applicable)?

_____ (72) _____ (73)

Code:
01 Electrical
02 Electronics
03 Mechanical and Industrial Engineering
04 Design/Packaging
05 Chemical
06 Materials
07 Biotechnology
08 Food Science
09 Communication/Information Processing
10 Energy/Energy Conservation
11 Nuclear
12 Other (specify) _____

5.2 Who are the individuals who make the greatest contribution to process innovation

i) in your company (names and/or positions if possible)

_____

_____

ii) in other organizations in Manitoba?

_____

_____

5.3 Can you identify the most technologically innovative companies in your industry in Manitoba in the area of process innovation?

_____

_____

_____

6.0 What automated production systems of note do you have in your Manitoba operations?

Describe facilities _____

_____

_____

Listing of equipment related to these facilities.

_____

_____

_____

_____

_____

	YES	NO	
check for:			
- robots with			
- machine vision	____	____	(74)
- tactile sensors	____	____	(75)
- artificial intelligence	____	____	(76)
- CAD	____	____	(77)
- CAM	____	____	(78)
- computer integrated manufacturing (CIM)	____	____	(79)
- zero force cutting systems (laser or fluid jets)	____	____	(80)
- flexible manufacturing system	____	____	(81)
- integrated process control and quality assurance	____	____	(82)
- ultrasonics	____	____	(83)
- high speed machining (over 40,000 rpm)	____	____	(84)

7.0 In the next five years what are your intentions for improving your manufacturing process?

_____

_____

_____

_____

7.1 If you plan to hire more people for process innovation, what would their backgrounds be? How many?

_____

_____

8.0 Which manufacturing or processing-related occupations in your company have been affected the most by technological change during the past five years?

- positively (increase in jobs) _____

_____

- negatively (decrease in jobs) _____

_____

IV INFORMATION SYSTEMS

1.0 In what areas of your operations do you use automated information systems (ie: computers)?

	Yes	No	
Inventory Control	____	____	(85)
Product design	____	____	(86)
Manufacturing process	____	____	(87)
Marketing	____	____	(88)
Office/Secretarial	____	____	(89)
Management decision support	____	____	(90)

1.1 What personnel do you have for operating these systems?

_____

_____

_____

2.0 During the next five years, in what areas would you plan to upgrade existing systems or install new systems?

	Yes	No	
Inventory Control	____	____	(91)
Product design	____	____	(92)
Manufacturing process	____	____	(93)
Marketing	____	____	(94)
Office/Secretarial	____	____	(95)
Management decision support	____	____	(96)

2.1 For new systems development, to what degree would you rely on consulting versus in-house personnel?

Exclusively consultants	____	
Mostly consultants	____	
Evenly split	____	(97)
Mostly in-house personnel	____	
Exclusively in-house	____	

V. LINKAGES WITH THE TECHNOLOGICAL INFRASTRUCTURE

1.0 On a scale of 1 to 4, where 1 is not used, 2 is used but not useful, 3 is used and useful, and 4 is used and very useful, indicate how important the following groups are to you in contributing to both product development and process improvement.

	Product		Process		Describe if not useful
Customers	1 2 3 4	(98)	1 2 3 4	(104)	_____
Local consulting firms	1 2 3 4	(99)	1 2 3 4	(105)	_____
Non-local consulting firms	1 2 3 4	(100)	1 2 3 4	(106)	_____
Local suppliers	1 2 3 4	(101)	1 2 3 4	(107)	_____
Non-local suppliers	1 2 3 4	(102)	1 2 3 4	(108)	_____
Trade associations	1 2 3 4	(103)	1 2 3 4	(109)	_____

2.0 Do you have any linkage with Manitoba universities or colleges? What are they? What do they contribute to your organization?

_____

_____

_____

2.1 How suitable to your operations is the training provided by the community college and university system?

_____

_____

_____

3.0 What are the most important provincial and federal programs or agencies that you have used? How were they useful?

_____

_____

_____

_____

_____

_____

3.1 What types of government programs would you like to see that would be of most use to you?

_____

_____

_____

_____

4.0 Can you think of some things which inhibit you from adopting technological innovations?

_____

_____

_____

APPENDIX B

RATIONALE FOR SAMPLE SELECTION METHODOLOGY

Technology Audit: Rationale For Sample Selection Methodology

Prepared by Ron Humble: Manitoba Research Council

Sample Methodology

It was determined that a qualitative, purposeful sampling approach would best suit the study objectives, as opposed to a quantitative statistical, random sampling method.

M. Q. Patton 1,2 has outlined in some detail the pros and cons of both qualitative and quantitative research methods. It is generally considered that each basic approach, or a combination, is appropriate for specific research objectives.

The general purpose of the quantitative approach is to avoid systematic bias in a sample. Hence, a large sample size is crucial for making generalizations. A simple random sample attempts to achieve a representative sample that permits generalizations to whole populations, while stratified random and cluster samples are intended to increase confidence in making generalizations to particular sub-groups or areas. The quantitative approach emphasizes deductive reasoning, or drawing specific conclusions from general principles.

A qualitative approach uses purposeful sampling in an effort to increase the utility of data obtained from relatively small samples. Such a case study approach has been pioneered by the social sciences of sociology and anthropology. The approach emphasizes logical, as opposed to statistical, generalizations by seeking common patterns in diverse groups by obtaining in-depth "pictures" of core elements specific to each case. As such, a measurement of "central tendency" somewhat different than statistical central tendency can be obtained by the analysis of information-rich, critical cases. Information can be provided to decision-makers that may be particularly troublesome or enlightening, such as outstanding successes or notable failures, that would be diffused in a statistical analysis. The qualitative approach emphasizes inductive reasoning or drawing general conclusions from particular instances.

1 Michael Quinn Patton, Qualitative Evaluation Methods, (New York: Sage Publications, 1980).

2 Michael Quinn Patton, "Qualitative Methods and Approaches: What are They?" In E. Kuhns and S. V. Martorana (eds.), New Directions for Institutional Research (San Francisco: Jossey-Bass, 1982)

In general, the qualitative approach permits the logical generalization and maximum application of data to other similar cases because "if it's true in this case, it's likely to be true in other similar situations". Such an approach also maximizes time, money and effort (which has been particularly relevant to the present study).

APPENDIX C

SELECTED CROSSTABS FROM SURVEY RESULTS

LIST OF TABLES

		Page
Table 1:	Head Office by Sales	C1
Table 2:	Head Office by How Advanced Product Technology	C2
Table 3:	Sales by How Advanced Product Technology	C3
Table 4:	R & D by How Advanced is Product Technology	C4
Table 5:	Industry by How Advanced is Product Technology	C5
Table 6:	Source of Technical Expertise - Product by Head Office	C6
Table 7:	Source of Technical Expertise - Product by Sales	C7
Table 8:	Locus for Product Development Decision by Head Office	C8
Table 9:	Process - How Advanced with Canada by Industry	C9
Table 10:	Process - How Advanced with World by Industry	C10
Table 11:	Process - How Advanced with World by Head Office	C11
Table 12:	Process - How Advanced with World by Sales	C12
Table 13:	Process - How Advanced with World by R & D	C13
Table 14:	Source of Technical Expertise - Process by Head Office	C14
Table 15:	Source of Technical Expertise - Process by Sales	C15
Table 16:	Locus for Process Improvement Decision by Head Office	C16

Interpretation of Cross-tabs Tables

Each crosstabulation table shows the relationship between two selected variables for all observations in the sample or population. The possible values of the row variable are presented along the top of the table while the values for the column variable are down the left hand side. Each cell represents the intersection of two values - one from the row variable and one from the column variable.

The first entry in the cell is the number of cases, or frequency, in that cell. It is labelled as COUNT in the key printed in the upper-left corner of the table. The second entry is the row percentage (ROW PCT). It is the number in the cell shown as a percentage of the row total. (ie: the number at the right-hand side of the table). Using Table 1 as an example, there are 6 firms which did not report their 1984 sales. Of these 6 firms, 50.0% have their head office in Manitoba, 33.3% have it in Canada, 16.7% in the U.S. and 0% elsewhere.

The column percentage (COL PCT) is the third number in the cell shown as a percentage of the total (ie: the number at the bottom of the table). For example, 2.1% of firms with head offices in Manitoba did not report their sales figure, and 13.8% of Manitoba based firms reported sales under a half million dollars.

TABLE 8

Locus for Product Development Decision by Head Office

Crosstabulation: V04 HEAD OFFICE By V47 PROD DECISION

V04	Count / Row Pct / Col Pct / Tot Pct	V47-> NA (0.0)	IN MB (1.00)	NOT IN MB (2.00)	BOTH (3.00)	Row Total
MB	1.00	4	137	2	2	145
		2.8	94.5	1.4	1.4	73.2
		80.0	86.7	6.5	50.0	
		2.0	69.2	1.0	1.0	
CDA	2.00	1	13	23	1	38
		2.6	34.2	60.5	2.6	19.2
		20.0	8.2	74.2	25.0	
		.5	6.6	11.6	.5	
US	3.00		7	6	1	14
			50.0	42.9	7.1	7.1
			4.4	19.4	25.0	
			3.5	3.0	.5	
OTHER	4.00		1			1
			100.0			.5
			.6			
			.5			
	Column Total	5 2.5	158 79.8	31 15.7	4 2.0	198 100.0

Number of Missing Observations = 0

TABLE 9

Process-How Advanced with Canada by Industry

Crosstabulation: V03 INDUSTRY By V63 MFG TECH ADV-CDA

V03	Count / Row Pct / Col Pct / Tot Pct	V63-> 0.0 INA	1.00 MORE ADVANCED	2.00 SAME	3.00 LESS ADVANCED	4.00 DK	Row Total
1.00 CHEM		1	7	15	5		28
		3.6	25.0	53.6	17.9		14.1
		10.0	11.9	15.5	16.7		
		.5	3.5	7.6	2.5		
2.00 WOOD			6	9	2		17
			35.3	52.9	11.8		8.6
			10.2	9.3	6.7		
			3.0	4.5	1.0		
3.00 METAL		1	6	19	6		32
		3.1	18.8	59.4	18.8		16.2
		10.0	10.2	19.6	20.0		
		.5	3.0	9.6	3.0		
4.00 MACH		1	12	20	5	1	39
		2.6	30.8	51.3	12.8	2.6	19.7
		10.0	20.3	20.6	16.7	50.0	
		.5	6.1	10.1	2.5	.5	
5.00 ELECTRICAL		3	5	20	9	1	38
		7.9	13.2	52.6	23.7	2.6	19.2
		30.0	8.5	20.6	30.0	50.0	
		1.5	2.5	10.1	4.5	.5	
6.00 FOOD			14	8	3		25
			56.0	32.0	12.0		12.6
			23.7	8.2	10.0		
			7.1	4.0	1.5		
7.00 CLOTH			7	4			11
			63.6	36.4			5.6
			11.9	4.1			
			3.5	2.0			
8.00 NONMFG-OTHER		4	2	2			8
		50.0	25.0	25.0			4.0
		40.0	3.4	2.1			
		2.0	1.0	1.0			
Column Total		10 5.1	59 29.8	97 49.0	30 15.2	2 1.0	198 100.0

Number of Missing Observations = 0

TABLE 10

Process-How Advanced with World by Industry

Crosstabulation: V03 INDUSTRY By V64 MFG TECH ADV-OUTSIDE

V64-> / V03	Count / Raw Pct / Col Pct / Tot Pct	NA 0.0	MORE ADVANCED 1.00	SAME 2.00	LESS ADVANCED 3.00	DK 4.00	Row Total
1.00 CHEM	Count		4	13	9	2	28
	Raw Pct		14.3	46.4	32.1	7.1	14.1
	Col Pct		10.5	15.7	15.8	16.7	
	Tot Pct		2.0	6.6	4.5	1.0	
2.00 WOOD	Count	1	3	6	6	1	17
	Raw Pct	5.9	17.6	35.3	35.3	5.9	8.6
	Col Pct	12.5	7.9	7.2	10.5	8.3	
	Tot Pct	.5	1.5	3.0	3.0	.5	
3.00 METAL	Count		1	20	9	2	32
	Raw Pct		3.1	62.5	28.1	6.3	16.2
	Col Pct		2.6	24.1	15.8	16.7	
	Tot Pct		.5	10.1	4.5	1.0	
4.00 MACH	Count		10	13	12	4	39
	Raw Pct		25.6	33.3	30.8	10.3	19.7
	Col Pct		26.3	15.7	21.1	33.3	
	Tot Pct		5.1	6.6	6.1	2.0	
5.00 ELECTRICAL	Count	4	4	17	12	1	38
	Raw Pct	10.5	10.5	44.7	31.6	2.6	19.2
	Col Pct	50.0	10.5	20.5	21.1	8.3	
	Tot Pct	2.0	2.0	8.6	6.1	.5	
6.00 FOOD	Count		11	8	6		25
	Raw Pct		44.0	32.0	24.0		12.6
	Col Pct		28.9	9.6	10.5		
	Tot Pct		5.6	4.0	3.0		
7.00 CLOTH	Count		4	3	3	1	11
	Raw Pct		36.4	27.3	27.3	9.1	5.6
	Col Pct		10.5	3.6	5.3	8.3	
	Tot Pct		2.0	1.5	1.5	.5	
8.00 NONMFG-OTHER	Count	3	1	3		1	8
	Raw Pct	37.5	12.5	37.5		12.5	4.0
	Col Pct	37.5	2.6	3.6		8.3	
	Tot Pct	1.5	.5	1.5		.5	
Column Total		8 4.0	38 19.2	83 41.9	57 28.8	12 6.1	198 100.0

Number of Missing Observations = 0

TABLE 11

Process-How Advanced with World by Head Office

Crosstabulation: V04 HEAD OFFICE By V64 MFG TECH ADV-OUTSIDE

V04	Count / Row Pct / Col Pct / Tot Pct	V64-> NA 0.0	MORE ADVANCED 1.00	SAME 2.00	LESS ADVANCED 3.00	DK 4.00	Row Total
MR	1.00	6	24	63	42	10	145
		4.1	16.6	43.4	29.0	6.9	73.2
		75.0	63.2	75.9	73.7	83.3	
		3.0	12.1	31.8	21.2	5.1	
CDA	2.00	2	10	13	12	1	38
		5.3	26.3	34.2	31.6	2.6	19.2
		25.0	26.3	15.7	21.1	8.3	
		1.0	5.1	6.6	6.1	.5	
US	3.00		4	6	3	1	14
			28.6	42.9	21.4	7.1	7.1
			10.5	7.2	5.3	8.3	
			2.0	3.0	1.5	.5	
OTHER	4.00			1			1
				100.0			.5
				1.2			
				.5			
	Column Total	8 4.0	38 19.2	83 41.9	57 28.8	12 6.1	198 100.0

Number of Missing Observations = 0

TABLE 12

Process-How Advanced with World by Sales

Crosstabulation: V05 SALES By V64 MFG TECH ADV-OUTSIDE

V05	V64->	NA 0.0	MORE ADVANCED 1.00	SAME 2.00	LESS ADVANCED 3.00	DK 4.00	Row Total
NA	0.0	1	2	2	1		6
		16.7	33.3	33.3	16.7		3.0
		12.5	5.3	2.4	1.8		
		.5	1.0	1.0	.5		
<.5M	1.00	4	2	10	6	2	24
		16.7	8.3	41.7	25.0	8.3	12.1
		50.0	5.3	12.0	10.5	16.7	
		2.0	1.0	5.1	3.0	1.0	
.5-.9M	2.00		4	7	4	3	18
			22.2	38.9	22.2	16.7	9.1
			10.5	8.4	7.0	25.0	
			2.0	3.5	2.0	1.5	
1-1.9M	3.00		1	11	4	2	18
			5.6	61.1	22.2	11.1	9.1
			2.6	13.3	7.0	16.7	
			.5	5.6	2.0	1.0	
2-4.9M	4.00		4	14	13	2	33
			9.4	42.8	40.6	6.2	16.2
			7.9	16.9	22.9	16.7	
			1.9	7.1	6.6	1.0	
5-9.9M	5.00	1	6	16	9	1	31
		3.2	19.4	45.2	29.0	3.2	15.7
		12.5	15.8	16.9	15.8	8.3	
		.5	3.0	7.1	4.5	.5	
10-19.9M	6.00		8	7	6	2	23
			34.8	30.4	26.1	8.7	11.6
			21.1	8.4	10.5	16.7	
			4.0	3.5	3.0	1.0	
20-49.9M	7.00		8	9	7		24
			33.3	37.5	29.2		12.1
			21.1	10.8	12.3		
			4.0	4.5	3.5		
50-99.9	8.00			4	1		5
				80.0	20.0		2.5
				4.8	1.8		
				2.0	.5		
100-500M	9.00	1	1	2	4		8
		12.5	12.5	25.0	50.0		4.0
		12.5	2.6	2.4	7.0		
		.5	.5	1.0	2.0		
>500	10.00			1			1
				100.0			.5
				1.2			
				.5			
REF	11.00	1	7	2	7		8
		12.5	37.5	25.0	25.0		4.0
		12.5	7.9	2.4	3.5		
		.5	1.5	1.0	1.0		
	Column Total	8 4.0	38 19.2	83 41.9	57 28.8	12 6.1	198 100.0

Number of Missing Observations = 0

TABLE 13

Process-How Advanced with World by R & D

Crosstabulation: V64 MFG TECH ADV-OUTSIDE By V11 R&D-($000)

V64	Count / Row Pct / Col Pct / Tot Pct	V11-> NA 0.0	<50 1.00	50-99 2.00	100-199 3.00	200-299 4.00	300-399 5.00	400-499 6.00	500+ 7.00	REF 8.00	Row Total
NA	0.0	1	2	1	2	1			1		8
		12.5	25.0	12.5	25.0	12.5			12.5		4.0
		2.0	3.2	7.1	7.1	7.1			6.7		
		.5	1.0	.5	1.0	.5			.5		
MORE ADVANCED	1.00	11	6	2	8	3	5	2	1		38
		28.9	15.8	5.3	21.1	7.9	13.2	5.3	2.6		19.2
		22.4	9.7	14.3	28.6	21.4	62.5	33.3	6.7		
		5.6	3.0	1.0	4.0	1.5	2.5	1.0	.5		
SAME	2.00	20	30	4	10	7	2	2	7	1	83
		24.1	36.1	4.8	12.0	8.4	2.4	2.4	8.4	1.2	41.9
		40.8	48.4	28.6	35.7	50.0	25.0	33.3	46.7	50.0	
		10.1	15.2	2.0	5.1	3.5	1.0	1.0	3.5	.5	
LESS ADVANCED	3.00	13	20	6	6	2	1	2	6	1	57
		22.8	35.1	10.5	10.5	3.5	1.8	3.5	10.5	1.8	28.8
		36.5	32.3	42.9	21.4	14.3	12.5	33.3	40.0	50.0	
		6.6	10.1	3.0	3.0	1.0	.5	1.0	3.0	.5	
DK	4.00	4	4	1	2	1					12
		33.3	33.3	8.3	16.7	8.3					6.1
		8.2	6.5	7.1	7.1	7.1					
		2.0	2.0	.5	1.0	.5					
	Column Total	49	62	14	28	14	8	6	15	2	198
		24.7	31.3	7.1	14.1	7.1	4.0	3.0	7.6	1.0	100.0

Number of Missing Observations = 0

TABLE 14

Source of Technical Expertise-Process by Head Office

Crosstabulation: V04 HEAD OFFICE By V66 MFG EXPERTI

V04	V66->	0.0	1.00	2.00	3.00	4.00	Row Total
	Count						
	Row Pct	NA	IN ORG IN MB	IN ORG OT MB	NOT ORG IN MB	NOT ORG NOT MB	
	Col Pct						
	Tot Pct						
1.00		7	89	5	11	33	145
MB		4.8	61.4	3.4	7.6	22.8	73.2
		87.5	77.4	25.0	100.0	75.0	
		3.5	44.9	2.5	5.6	16.7	
2.00		1	18	11		8	38
CDA		2.6	47.4	28.9		21.1	19.2
		12.5	15.7	55.0		18.2	
		.5	9.1	5.6		4.0	
3.00			7	4		3	14
DS			50.0	28.6		21.4	7.1
			6.1	20.0		6.8	
			3.5	2.0		1.5	
4.00			1				1
OTHER			100.0				.5
			.9				
			.5				
Column Total		8 4.0	115 58.1	20 10.1	11 5.6	44 22.2	198 100.0

Number of Missing Observations = 0

TABLE 15

Source of Technical Expertise-Process by Sales

Crosstabulation: V05 SALES By V66 MFG EXPERT1

V05	Count / Row Pct / Col Pct / Tot Pct	V66-> 0.0	1.00	2.00	3.00	4.00	Row Total
NA	0.0	1	3	1		1	6
		16.7	50.0	16.7		16.7	3.0
		12.5	2.6	5.0		2.3	
		.5	1.5	.5		.5	
<.5M	1.00	3	10	3	4	4	24
		12.5	41.7	12.5	16.7	16.7	12.1
		37.5	8.7	15.0	36.4	9.1	
		1.5	5.1	1.5	2.0	2.0	
.5-.9M	2.00		12	1	4	1	18
			66.7	5.6	22.2	5.6	9.1
			10.4	5.0	36.4	2.3	
			6.1	.5	2.0	.5	
1-1.9M	3.00		14	3		1	18
			77.8	16.7		5.6	9.1
			12.2	15.0		2.3	
			7.1	1.5		.5	
2-4.9M	4.00	1	21	2	2	6	32
		3.1	65.6	6.3	6.3	18.8	16.2
		12.5	18.3	10.0	18.2	13.6	
		.5	10.6	1.0	1.0	3.0	
5-9.9M	5.00	1	17	3	1	9	31
		3.2	54.8	9.7	3.2	29.0	15.7
		12.5	14.8	15.0	9.1	20.5	
		.5	8.6	1.5	.5	4.5	
10-19.9M	6.00		10	1		12	23
			43.5	4.3		52.2	11.6
			8.7	5.0		27.3	
			5.1	.5		6.1	
20-49.9M	7.00		14	3		7	24
			58.3	12.5		29.2	12.1
			12.2	15.0		15.9	
			7.1	1.5		3.5	
50-99.9	8.00		3	1		1	5
			60.0	20.0		20.0	2.5
			2.6	5.0		2.3	
			1.5	.5		.5	
100-500M	9.00	1	5	1		1	8
		12.5	62.5	12.5		12.5	4.0
		12.5	4.3	5.0		2.3	
		.5	2.5	.5		.5	
>500	10.00			1			1
				100.0			.5
				5.0			
				.5			
REF	11.00	1	6			1	8
		12.5	75.0			12.5	4.0
		12.5	5.2			2.3	
		.5	3.0			.5	
	Column Total:	8 4.0	115 58.1	20 10.1	11 5.6	44 22.2	198 100.0

Number of Missing Observations = 0

TABLE 16

Locus for Process Improvement Decision by Head Office

Crosstabulation: V04 HEAD OFFICE By V69 PROCESS DECISION

V04	V69->	NA (0.0)	IN MB (1.00)	NOT IN MB BUT IN BOTH (2.00)	(3.00)	Row Total
1.00 MB	Count	6	135	2	2	145
	Row Pct	4.1	93.1	1.4	1.4	73.2
	Col Pct	85.7	82.8	11.8	18.2	
	Tot Pct	3.0	68.2	1.0	1.0	
2.00 CDA	Count	1	18	14	5	38
	Row Pct	2.6	47.4	36.8	13.2	19.2
	Col Pct	14.3	11.0	82.4	45.5	
	Tot Pct	.5	9.1	7.1	2.5	
3.00 US	Count		9	1	4	14
	Row Pct		64.3	7.1	28.6	7.1
	Col Pct		5.5	5.9	36.4	
	Tot Pct		4.5	.5	2.0	
4.00 OTHER	Count		1			1
	Row Pct		100.0			.5
	Col Pct		.6			
	Tot Pct		.5			
Column Total		7	163	17	11	198
		3.5	82.3	8.6	5.6	100.0

Number of Missing Observations = 0

APPENDIX D

SELECTED COMMENTS FROM QUESTIONNAIRE

TABLE OF CONTENTS

		Page
1.	SECTION ON LINKAGES	D1
	Comments on Suitability of Training (Question 2.1)	D3
	Comments on Federal and Provincial Agencies Used (Question 3.0)	D7
	Comments on Government Programs Firms Would Like to See (Question 3.1)	D9
	Comments on Inhibitors of Technological Innovation (Question 4.0)	D22
2.	SECTION ON INFORMATION SYSTEMS	D24
	Personnel for Operating Information Systems	D24
3.	SECTION ON MANUFACTURING PROCESS	D31
	Occupations Affected by Technological Change	D31

LIST OF TABLES

		Page
Table 1:	Linkages with Universities and Colleges	D1
Table 2:	Suitability of Training	D2
Table 3:	Federal and Provincial Agencies Used	D5
Table 4:	Government Programs Firms Would Like to See	D8
Table 5:	Inhibitors of Technological Innovation	D21

TABLE 1

LINKAGES WITH UNIVERSITIES AND COLLEGES

INSTITUTION	MENTION	TESTING/ PROD. DEV.	CONSULTING/ DISCUSSION	COMMITTEES/ PROGRAMS	APPRENTICESHIP /RECRUITING
UM - General	3	20	7	5	3
Engineering					
- General	2	4	4	3	3
- Industrial			1	1	
- Mechanical		3	1	1	
- Electrical	1	1	2		
Science					
- General	1		1		
- Chemical		2	2	1	1
- Plants		1	1		
- Physics	1				
- Biology			1		
Admin. Studies			3	5	
Architecture				1	
Agriculture	1	3	8	1	1
Other			1	1	
Brandon U.		1	1		
Community College		1	1	1	5
RRCC					
- General	2	4		6	12
- Electrical				2	
- Technicians				1	
- Technologists	1				
- Quality Control		1			
Other	9	1	2		4
- ITC		1			
- IAMC		3			

None/Not Used	79
No Response	4

TABLE 2 - SUITABILITY OF TRAINING AT UNIVERSITIES AND COLLEGES

TOPIC	POSITIVE	NEGATIVE	MENTIONED (NEUTRAL)	NOT USED	SUGGESTION
University					
- General	2	16		2	1
UM - general	10	2	2		1
Engineering					
- General	5	8	3		2
- Industrial	3	1			1
- Mechancial	1				
Science					
- Chemical	1				
- Biology, micro	1				
Admin. Studies	3		3		1
Agriculture	4				
Community College					
- General	7	4		1	
RRCC - General	19	6	2		1
- Mechanics	6		1		1
- Diesel	1				1
- Welders, fitters	5	2			
- Electrical	3	1			1
- Technicians	1				
- Technologists	4	1			
- Quality Control	1				
- Design	1	1			
- Clerical	1				
- Computer prog.	2				
- Other	10	2			2
Overall Comment not specifically directed at University or College	46	26	9	18	4
No Response	3				

2.1 How suitable to your operations is the training provided by the community college and university system?

Limited (Chemical Engineering Graduates would be suitable).

Community college good for diesel mechanics. Like people to have a little more field experience.

Red River C.C. -trained machinists need more experience.

Industrial engineering needs to be more practical in addition to theoretical training.

- Mechanical Engineers - ok.
- Industrial Engineers - a start.
- Really need experienced ones.

- RRCC machining courses do not apply; have to train to the equipment.
- Machinist apprenticeship program out of date.
- Even the new equipment at RRCC not right; need to be more in touch with what industry needs.
- River East Industrial Arts program - have 1 trainee - excellent.
- Training has to start in high school, even before apprenticeship program.
- Manitoba market not sophisticated enough for university industrial engineers.

- At the University level we find that we have to hire engineers from outside Canada because of the time they spend on power engineering. They do not spend enough time on power engineering - (at one time brought 70 families from U.K.

- Desperate need for CNC programmers and machine operators.

- RRCC - useful to small printer - not quite as useful to larger printer. Would like to see apprenticeship program.

- Good basic training - must do additional on the job training in-house.

- I would like them (RRCC) to train mechanical apprentices in Winnipeg, instead of in The Pas where they are trained in/for the mines.
- If looking for a mechanic, I would take one of our own people and send them through apprentice program.
- If looking for electrician, would look to RRCC for an industrial electrician.

- In-house training is necessary.

- University system good; however, more emphasis in the west on mining and metallurgical engineering would be of benefit.

- C.C. - in production and in data processing - good
- University senior mgmt.
  - in those areas training adequate but would like attitude improvement e.g. - a greater willingness to learn job.

- Need community college to train electronic people (not now done).
- University - suitable for training lab personnel.

- Actually about as good as it could be but please teach them to read, write and spell.

- Problem is that they come with too high expectations to start off. Have basic training but takes about 2 yrs. before they know what they are doing - learning tends to be more theoretical than practical. Would recommend that engineers out of U of M be sent for 1 yr. to RRCC. If had a choice I would choose a technician from RRCC because they are trained in more practical applications.

TABLE 3

FEDERAL/PROVINCIAL PROGRAMS USED

PROGRAM	MENTIONED	USEFUL	NOT USEFUL	TOTAL	COMMENTS/ SUGGESTIONS
FEDERAL	11	2		13	
MANPOWER	14	11	2		
- Job Creation	1	2			
- UIC Workshare	6	8	1		
- Training/Apprentice	21	13	3		
- Wage Subsidies	3	2			
TOTAL MANPOWER	45	36	6	87	
RESEARCH - IRAP	13	7	1		
- IERD	1				
- NRC	13	8			
TOTAL RESEARCH	27	15	1	43	
PLANT EXPANSION/EQUIPMENT	3	2			
- DREE/DRIE	50	21	3		2
- IRDP	2				1
TOTAL PLANT EXPANSION/EQUIPMENT	55	23	3	81	3
MARKETING	3	2	1		1
- PEMD	7	9	1		1
TOTAL MARKETING	10	11	2	23	2
FBDB/CASE	1	5	1	7	1
EDC		1		1	
TOTAL FEDERAL PROGRAMS	149	93	13	255	6

TABLE 3 (con't)

FEDERAL/PROVINCIAL PROGRAMS USED

PROGRAM	MENTIONED	USEFUL	NOT USEFUL	TOTAL	COMMENTS/ SUGGESTIONS
MANITOBA	5	3	5	13	
- Job Creation	1	2			
- Jobs Fund	5	2			
- Students	4	4			
- Career Start	5	1			
- Apprentice	3				
TOTAL JOB-RELATED	18	9		27	
INDUSTRY, TRADE & TECHNOLOGY	7	5		12	
BUSINESS DEVELOPMENT	1				
- Venture Capital	2				
TOTAL BUSINESS DEVELOPMENT	3			3	
ITC	12	7	1	20	
MBA CONSULTANTS	1	1		2	
CFPDC	5	2		7	
TOTAL PROVINCIAL PROGRAMS	51	27	6	84	
OTHER	51	23	6	80	6
TOTAL PROGRAMS USED	251	143	25	419	12

NOT USED - 25
PROVINCE - NOT USED - 4
NO RESPONSE - 4

3.0 What are the most important provincial and federal programs or agencies that you have used? How were they useful?

- CAD/CAM training - improve design capability. Overseas marketing program.

- Do not use any programs - paper work too much, plus a policy not to.

- FBDB - CASE - reasonably useful - could have been more useful if had continued to use.
- Feels company should take more advantage.

- IRDP - would be most useful if run better - maximum allowable is too low.

- Have used some however we are not impressed. The quantity of paperwork plus the percentage return against cost of project does not justify the time expended on it.
- We try not to use them.

- Too much of a hassle to qualify for some programs-not worth the expense.

- Working with agencies who want to work for handicapped people.

- PAMI - for testing.
- Have tried some programs - DREE to help with $1/4 million expansion but people in federal government didn't know what they were doing - agent was a used car salesman from B.C. - did not complete application for grant.

- PEMD - good, but should be modified to accomodate more than one visit.
- DRIE - old DREE was a better program.

- Very important, but some things could have been done differently.
- Federal grant to move to Manitoba.
- Provincial/City ties as well.

- Will make use of some programs from time to time (i.e. STEP training grants). Have put together some joint ventures with DOC where they provided some funding - very useful. Because we are a Crown Corporation, we are morally and legally precluded from partaking in them.

- None - too much paperwork - governments spend $millions on programs that are not useful or applicable - do not relate to situations at hand - not realistic or practical.

TABLE 4

GOVERMENT PROGRAMS YOU WOULD LIKE TO SEE

PROGRAM	MENTION/ CONTINUE	REDUCE/ ELIMINATE	ENHANCE	COMMENTS/NEW PROGRAM POLICIES
Training - Jobs	7	1	11	22
Gov't Reg/Involvement		11		
Taxes		3	1	8
- payroll tax		7		
- incentives			2	4
- excise		1	1	1
- tariffs		2		
- subsidies			1	
Specific Grant Prog - IRAP, R & D, DREE, equip., EDP, Western Transp. Init.Prog., housing.	9		7	35
Other Programs - counselling services in exp.finance, market R & D.	3		4	17
Specific Departments eg. DRIE	2		3	5
Other - labour law, everything, spending (policies)	4	5	5	17
None/Don't Know	19			
OK - What We Have Now	9			
No Response	11			

3.1 What types of government programs would you like to see that would be of most use to you?

TRAINING/JOBS

- More user-appropriate training and development programs - have users involved in determining what is needed.

- Encourage more young people to become involved in the dairy business.
- most supervisory people come up through the ranks and are not trained in the schools - don't have dairy science background.
- 3 out of 5 people are from outside, from Canada.

- Up-to-date video-training programs developed federally for in-plant use or at least an assistance program to purchase U. S. tapes.
- Need a training unit for basic industrial manufacturing.

- Technical training in milling and sanitation.

- Training programs - Career Start.

- Gov't grants to support job creation and training.

- Training program - something to pay people while they are being trained - it costs a lot of money to train people.

- Training subsidy programs where training conducted <u>in industry</u> - cooperative training, industry & school.

- More technical information - training of people and programs.

- Assistance in R&D; continue assistance in the training of technical people - continue support for improving manufacturing system/equipment.

- Need training programs for industrial chemical technician.

- Government programs should be directed at job creation in new technology not being performed in Manitoba.

- Education with more discipline and justice to produce more responsible worker.

- More courses offered in the rural areas such as Portage.

TRAINING/JOBS (con't)

- Like to see the "NEED program" reinstituted.
- Educational - General program to upgrade the metallurgical knowledge at an operator level.
- Upgrade electricians for solid state instrument technology.

- Training at community college level for sheet metal electrical workers.

- Teach on testing equipment and what is available.

- Canada Manpower Federal training program through In Plant Training Program.
- Apprenticeship - fabrication.

- Industrial plastics education program.

- Courses that educate the mass of people about the advantages of technological change and the use of computers in everyday life.

- An apprenticeship program and an applied research institute here in the province.

- Programs too cumbersome, time-consuming. e.g. Career Start - too much paperwork to operate.
- Tracking is more expensive than hiring off the street.

- Course to upgrade bakers, candymakers, sanitation program; but would have to bring instructors in from out of province.

- More.
- Make it advantageous for a company to use an apprenticeship program depending on how it's set up.
- Put funding into better education for manufacturing & business.
- Like to see fewer programs & more practical programs & relevant programs.

TAXES

- Tax concessions for capital acquisition and employment programs.

- For Research & Development - greater tax incentives.

- There are no programs have in mind - lower corporate taxes.

- Tax incentives to manufacturers for expansion purposes.
- Lower duty rates on fabrics.
- Provincial labour law - repeal.

- Purchased pollution control equipment ($250,000). It was provincially taxable. Would like assistance, not taxing, to assist and encourage pollution control.

- More incentives for secondary industry related to our natural resources (ie: Agriculture) within Manitoba.

- Provincial gov't to become more business-oriented.
- Key to jobs is for companies to be successful.
- Less made in Manitoba expenses - min. wage, payroll tax.
- General attitude towards companies needs to change.

- Would like to see incentives for generating new investment for machinery (i.e. upgrading equipment). There is a lot of new equipment out there that we cannot afford to purchase and therefore we cannot compete against the big companies.

- R & D Tax Credits.
- Technical Assistance for prod'n/process innovations.

- Tax credit program for R. & D. enhanced as opposed to grant programs.
- Availability of programs to advise companies of export opportunities.

- Set up tax incentives for R. & D. and educational opportunities.
- If there should be tax incentives for jobs instead of taxing jobs - remove the payroll tax.

- We would like a study group to be formed consisting of financial people from the Federal and Provincial Governments to analyze a more equitable taxation system for our products.

TAXES (con't)

- Some type of accelerated tax write-offs for expenditures on process and product innovation.
- The problem with growth companies is cash flow.

- Excise tax - raise the min. amt. from $50,000 to $1.5M before liability of excise tax is applied. This would generate great growth in the small manufacturing segment & raise employment.

- Let them leave business alone - take away some of the tax burdens.
- Develop more programs for small business.
- Economy is not based on developing Limestone and selling/subsidizing the Americans.
- If had a bit of that $3B we could start up 5 new businesses.

SPECIFIC GRANT PROGRAMS

- Programs of the EDP type which assist in the speed of product development, with preference for commercially viable products rather than high risk ones.

- Merit rebate system for workers compensation.
- More comunications with manufacturing on new legislation.

- Programs which provide access to equipment and/or laboratory facilities for R & D on a periodic basis when needed. (i.e. machine which is very expensive and is only required for two days.)

- A program which would facilitate importing of materials and equipment for the industry.

- C.I.D.A. should give more flour than wheat, ie: export value - added product.

- More money for research and market development, ie: methanol.

- Assistance in modernizing equipment & facilities; R&D; tax incentives (R&D, modernization); assistance for finance & exporting.

- Modernization of equipment & facilities.
- Familiarization with trade opportunities in third world countries.
- Lower threshold levels for projects - financing for smaller projects.

- Off-oil program!

- Funding programs for modernization and technological improvement - like to see more of it.
- Orderly marketing to assure that domestic producers can

- Program directed at development of products and innovative processing.
- Cost-sharing grants most useful.
- Job creation is not as important unless it results in a saleable product.

- Research and Development support.
- In manufacturing process: capital expenditure support.

- Assistance for capital acquisition; R&D support; "less red tape provincially".

SPECIFIC GRANT PROGRAMS (con't)

- Programs where larger companies qualify for product development grants, and grants to improve manufacturing processes.
- Aid with training.

- Would like to see RESI program re-established.

- Programs to assist Canadians to buy American-owned companies in order to maintain employment levels.

- Program to assist financially in implementing the new processes which result from new product development.

- Make IRDP more straightforward with realistic levels for grants.

- Product development programs - not so restrictive to radical changes but product improvement.

- Costs of environmental protection controls.
- Investigations and Equipment - either written off quicker or with money input.
- Concept of supporting strong performers e.g. CIRB
- Programs that improves products to compete internationally.
- Upgrading product to compete with Germany, Korea, Japan etc. quality first concepts.

- Do not discontinue current programs. Gov't support for manufacturing to remain competitive plus Science & Tech. type facility locally.

- Expert program is good but needs to be more flexible.
- Consulting on productivity improvements, workflow, organization of plant layout.

- Government supported R. & D. by the private sector.

- I think the DREE type programs are useful. Programs on Energy Conservation and the use of microelectronics are all helpful.
- Would like to see these kinds of programs where there is an encouragement to use new technology. The best are where you have the ability to chose how you want the technology transferred and not have someone else decide for you.

SPECIFIC GRANT PROGRAMS (con't)

- Would like to see a lot more financial assistance available.
- I think they need to increase the amount of financial assistance which is available. (e.g. IRDP - only funds 25%, would be useful if 50-75% of funding available.)

- A program encouraging use of Canadian food ingredients in Federal food aid programs.

- Productivity Improvement Programs.

- Product development grants.

OTHER PROGRAMS

- Expansion/dev. - Marketing - foreign & domestic - support for printed materials, promotional, manuals.

- Gov't support for equipment acquisition.
- Need a mechanism or forum at the provincial level to help local companies in dealing with federal agencies.

- Assistance for financial negotiations (with banks).
  - Help explain technical ramifications of projects.
  - Loan guarantees?

  (We may be able to provide this expertise to the banks; have worked on expropriations in past.)

- Assistance to capital programs and projects.

- Would have liked the government to have kept some of the old programs.

- Programs to allow Manitoba industry to be on same competitive footing as Ontario and Alberta.

- Programs which are TIMELY and meet contractual and scheduling needs of industry eg.: test reports.
- Modernization and expansion programs.

- Processing consultants to make recommendations for improvements - could be funding for the consultants or direct consultants.

- Export assistance.

- Either gov't engineer re: product development, or financial assistance to hire engineers for product development.

- Some involvement with the actual carrying out of developing a product line.
- Gov't marketing support - they have expertise in marketing.
- Company wouldn't take any profits until gov't has recovered its costs.

- Export marketing support.

- Consultation services - for advice with Dep'ts. of Agriculture, and Industry, Trade and Technology.

OTHER PROGRAMS (con't)

- Low cost interest to promote export. Federal financial support for shows in U.S. and Europe.

- I am not a good Administrator - concentrate more on ideas/concepts.
- Would like some assistance in this area (i.e. someone to help organize and run business.)

- Access to professional assistance on what appears to be simple production problems on a verbal basis without making a major project out of things.

- Would like to see a program to get some assistance for marketing and financing.
- Would like the gov't to provide some type of incentive to small deserving manUfacturers such as myself to develop new innovations.
- Development costs tend to cut up any funds that could be used for marketing.

SPECIFIC DEPARTMENTS

- Applied Research Institute if becomes part of IMT.

- Build the promised Manufacturing Technology Research Centre in Wpg., as a display rather than a research centre.

- Consolidation of federal government's purchasing department & access to purchasing intentions of all governments (Federal, Provincial, Municipal).

- Man. Technological Committee -
- M.R.C. - thinks it should be reviewed & <u>evaluated</u>.
  - questioning - is it advantageous research?
  - Are the feds underwriting?
- Industry has to pay own way & government's way - when times get tough industry lightens but when does gov't cut back.
- Are we getting our money's worth?
- Is the board now NDP cronies?

- Elimination of bureaucratic duplication. - call under a number of dept's. (i.e. Health of Animals, Health Protection Branch, etc.) and can end up with them all here on same day.
- Would like to do away with duplication.

OTHER

- Find some way of distributing the CAD technology to smaller firms (i.e. to make it financially possible for them to adopt it).
- Large gov't operated system is not accessible enough.

- Less complicated programs.
- More relief.

- Not being a user, doesn't really know. Flexibility in the program and the terms of the contract. Some programs make it too easy for people to get into things they shouldn't be in YET.

- Wider dissemination of what programs are available.

- Anything that helps sell energy conservation.

- Should think of country as a group of companies and spearhead the direction/niche for Canada to fulfill eg: electronics in medicine.
- SWAT team for management assistance: put segments together to use to make grants. Be more sensible, eg: Flyer had weak management.

- Regulations and paperwork often prevent use of programs.

- Would like to see less gov't interference.
- With some of the programs they have put in they keep companies in business who shouldn't be in business.

- Textile and apparel policy.
- Establish a policy that's clear-cut so that manufacturers know how they will stand in the future.

- Anything that would help reduce energy costs would be useful.

- Make gov't more cognizant of breaking down their orders. (e.g. federal gov't could split its tenders).

- Discontinue grants; if anything, they help too many sinking ships-or distribute grants more fairly including viable businesses.

- Would like to see some controls put on Safeway to encourage them to support Manitoba food processing.

OTHER (con't)

- Honor claims to buy Manitoba (speaking of prov. gov't).
- Elimination of red tape associated with selling to federal gov't.
- No incentive to bring new industry to Manitoba.
- Existing programs fine - (Simplify paperwork).
- Should do away with grants, etc. and make loans available on a low interest basis because if we give money away there is no incentive to make venture work and pay money back.

TABLE 5

WHAT INHIBITS ADOPTION OF TECHNOLOGICAL INNOVATION

	NUMBER OF RESPONSES		SPECIFIC PROBLEM MENTIONED
Company's Lack of Expertise	16	(6.9%)	2
Market Size/Demand/Maturity	29	(12.4%)	
Economy/Market Uncertainty	11	(4.7%)	
Government	4	(1.7%)	9
Finances/Cost/Money	97	(41.6%)	3
Risk/ROI/Time to Recoup Investment	17	(7.3%)	1
Other*	32	(13.8%)	6
Nothing/No	23	(9.9%)	
No Response	4	(1.7%)	
TOTAL	233	100.0%	21

* Other includes: obsolescence, geographical location, lack of information, size of company, education, unions, future of industry, food regulations, noise levels, foreign currency exchange, lack of supplies, resistance to change, product mix, economies of scale, loss of workload, innovate too quickly.

4.0 Can you think of some things which inhibit you from adopting technological innovations?

- Access to equipment and/or laboratories for R. & D. on a periodic basis when needed.

- Help with consumers to broaden their acceptance of new products and packaging i.e. tamper proof seal.

- Cost and <u>risk</u> (if you could write it off 100%).

- Small manufacturer does not have know-how to develop international markets.
- Need assistance for exploration/communication non-political preferably.

- Provincial government - excess sales taxes on production equipment.
- Lack of qualified repair personnel for high - tech equipment.
- Manitoba is too far behind technologically - distribution centres are all in Ont. or Alta. (tax haven).

- No - CSA standards regulations.

- Tax system in Canada - and getting worse. Payroll tax in Manitoba.
- Reform of taxation on:
  1. depreciation.
  2. export earnings.

- Proposed provincial labour legislation.

- Need a better trained work crew base.

- Legislation - re: labour.

- Expenses - some things are coming down in price but others are more expensive e.g. robots
- Access & quality of technological information available could be improved.

- Government competition in the field.
- Reduces profit margins to the point where money is not available for technological innovations.

- 6% sales tax.

- Money - new equipment is very expensive, whole old system would have to be torn out.

- Most automated equipment has too much capacity for the smaller manufacturer - geared toward oil companies.

- Payroll tax.
- 50% increase in workmen's compensation.
- Pregnancy leave.
- Minimum wage.

- Food and Drug act. e.g. irradiation is used by U.S. army but Food and Drug wouldn't allow it).
- Financial.
- Regulations.
- Unions give us a rough time about sick change.

- High interest rates - tax credit and incentive would help.
- R. & D. tax credit is a good system - faster tax write-off would help.
- Lower tariff barriers on equipment.

- Not really but the capital costs of some innovations (eg. automatic meter reading) is too expensive relative to existing manual procedures.

- Finances, for example, when laser equipment becomes more common it will likely be expensive.
- Personnel, for example some computerized equipment is complicated and requires highly intelligent operators.

SECTION ON INFORMATION SYSTEMS

1.1 What personnel do you have for operating automated information systems?

COMPUTER PROGRAMMERS

- computer specialists (5)
- one computer programmer (19)
- programmer (6)
- 1/2 programmer
- CNC programmer, programmer
- 2 computer programmers (3)
- computer programmers - these people are not the operators - train and support the users (user operator operation - all people not necessarily technical staff).
- 1 programmer, 1 supervisor
- 40 programmers and systems analysts
- programmer/software specialist
- computer programmer/analyst
- computer department - programmers
- 1 specialist
- programmers on contract
- 7 programmers
- data processing department - programmers/administration of machine use

SYSTEMS ANALYSTS

- 1 systems analyst (2)
- 1 analyst (4)
- systems analysts (3)
- EDP analyst and input operation (under finance)
- computer analyst
- 2 programmer analysts
- systems development group (3)
- 2 program analysts
- 1 senior systems programmer

KEYPUNCH/DATA PROCESSING

- 1 computer operator (8)
- computer operators (2)
- 2 operators (4)
- operators (12)
- terminal operators
- secretaries (3)
- clerks to operate
- 3 data entry operators
- 3 keypunch operators, PC operator
- data processing - 15 plus 50 others (office, sales) who operate personal computers
- data processing operators
- one data entry
- 2 input operators (payroll & accounts)
- 2 clerical support
- 3 data terminal operators
- data terminal operators & technicians
- 2 full-time computer support
- computer operators - purchase most of the software
- clerical in word processing
- entry operators (2)
- operator for system
- 1 keypunch operator
- word processor operator
- 50 full-time employees - every secretary and others
- data processors
- keypunch
- many keypunch and systems operatorS
- terminal operators all through company - word processing operators
- 14 terminal operators
- 2 1/2 keypunch operators
- 2 keypunch operators (MIS)
- 2 input operators
- 3 computer operators
- 1 clerical person
- 1 secretary
- 1 computer operator, 1 back-up operator
- computer operator and bookkeeper
- local operators

PRODUCTION-RELATED

- trend to upgrade equipment - CNC punching machines
- specialized personnel for computerized marking
- 2 engineers on CAD
- machine operators
- SIN-COM engineering group
- technologist in inventory control; engineer in manufacturing process
- CNC operator
- 3 engineers
- technicians operate spectrometer system for metallurgical analysis
- engineering staff - product design
- technicians
- experienced typesetters
- engineering personnel run their own programs
- engineering personnel, process operators, trades
- various departments of each specific facet of manufacturing process will operate and program their respective computers
- production people, very simple procedure
- engineers - inventory control/product design and technicians in manufacturing process
- production operators, 3 PC operators in technical areas

MANAGEMENT

- 1 computer (manager of information systems) - 3 or 4 others (trained by Price-Waterhouse)
- 1 part-time consultant
- 1 data centre manager Who is also a systems analyst
- various managers
- IBM PC - plant accountant and cost clerk
- DP manager
- computer manager and 3 support staff
- head office - computer manager
- 1 director of communications
- president and part-time person
- manager - MIS dep't; 1 supervisor, computer operations
- comptroller (2)
- manager of finance
- accounting
- computer services manager
- the product development manager
- manager of information services, data processing manager
- managers
- management 1, admin 1
- data processing manager
- managers/admin support - marketing/office/decision support

USE ANOTHER SOURCE

- in Vancouver - a data centre; in Winnipeg, no special personnel
- we use E. H. Price's staff
- other users - corporate computer facilities (U.S.)
- contract out (3)
- 2 people preparing input for outside computer company
- several people capable of programming linked to large MIS in U.S.
- computer specialist at head office in Saskatoon
- computers are programmed/software developed at the Canadian head office in Quebec
- the actual programs are run by an outside company - Cybershare
- done outside
- service bureau
- outside - service bureau
- service bureaus are used for accounting functions; use another company's computer for management decision support.
- computer office in Toronto
- have a combined computer system with parent company and they have computer specialists that operate these systems for us as well.
- software was custom designed for our use (admin)
- design and development: information systems department for whole company - head office support
- get assistance from head office and Sherritt Computer Centre in Sask/Alta.

NO SPECIFIC PERSONNEL

- regular staff use these systems
- regular staff learned
- wholesale store, lab - for info access; no one particular person
- users - no systems department; systems geared to user requirements.
- none specialized
- no specialized personnel
- all employees
- self-trained office staff
- used existing staff
- retrained own personnel
- users operating systems
- all office personnel use a computer
- part-time help as required to run computers
- in-house personnel trained (9)
- everyone (3)
- users (4)
- own employees trained on job
- office staff (2)
- in Manitoba, the people who are operating the systems we have would be those that are using them (ie: acct'g clerk uses payroll program, etc.)
- regular staff learned how
- president and all staff
- trained existing personnel (2)
- staff was trained
- 100 people
- computer group (8 people)
- 6 who work with computers (ie: know how to operate them)
- systems are operated by individuals using them (ie: secretaries)
- in-house personnel
- regular staff in all departments
- regular staff (3)
- users of PC's
- everyone operates the system to make inquiries
- end users
- university graduates from various disciplines, plus trained in-house employees.
- user of PC
- Inventory control purchasing, pattern shop, marketing - people in all areas
- administrative staff
- all 24
- regular staff trained
- administrative side
- stores people
- 3 in computer area and it is a user system (so everybody is using it)

NO SPECIFIC PERSONNEL (con't)

- some is conducted by individuals within each dep't (ie: office/mktg). Have a centralized group (CIS) that have responsibility for corporate information systems. MDS runs all billings, etc. - MTS is responsible for programs and they operate them.
- relevant people to each job operate these systems (ie: admin - acct'g, etc.)
- clerical/administrative
- admin staff - all uses: production planning is a basic part of system.

NONE (16)

- nil
- no real automated systems

NO RESPONSE (28)

SECTION ON MANUFACTURING PROCESS

8.0 Which manufacturing or processing-related occupations in your company have been affected the most by technological change during the past 5 years?

PRODUCTION WORKERS/MATERIALS HANDLING

Positive

- upgrading operators in pulp and paper.
- CNC machinists
- machinists
- machinists - skilled electrical mechanic due to complexity of controls
- assembly
- require a more mechanical background
- production laborers (requiring manual dexterity)
- in production because work load is higher
- production line
- production
- manufacturing jobs
- factory workers
- innovations resulted in greater production
- machinists
- machine shop winding operations (processes improved and therefore production improved)
- typesetting
- production workers
- production personnel
- working with new systems
- those specialized in electronic knitting
- production
- electronics training
- axle reconditioning and CNC machining
- in production staff
- machinists
- laminator operator
- mechanical and machining
- more technicians and the more educated people to handle the more skilled requirements
- number of products have increased so jobs have increased
- unskilled labor
- technically capable (people trained by the company)
- production workers (seasonal variation in numbers)
- part time for turret lathe
- materials control, machine operators, assembly workers
- electronics technicians
- have hired 2 production people to get started and will be hiring 10 more by summer
- production personnel

PRODUCTION WORKERS/MATERIALS HANDLING (con't)

Negative

- traditional tradesmen are being replaced by younger people who are production oriented
- routine production
- automation throughout plant
- materials handling
- fewer sewing operators
- modernization of zinc metal casting plant
- typesetters due to computerized typesetting
- materials handling
- punchpress operators and other unskilled labor
- typesetters are being totally retrained - also existing people
- bottling
- producing more with fewer people - economy more than technology
- due to automation
- labor, clerical
- materials handling - filleting semi-skilled
- materials handling because of crane system
- operations - trainmen
- reduction in lumber of 90
- punch press operators
- standard conventional machinists
- sewing operators
- sewing machine operators - have had to increase productivity
- production line personnel
- unskilled people in casting operation
- doing more with less - fewer production people - decrease in the lower skilled production occupations
- fewer production personnel
- moulding room floor
- typesetters
- unskilled, low skilled machine operators
  shut down one shift when we became more automated
- basically unskilled
- assemblers
- installation group - change was made more than 5 years ago when we switched away from electromechanical to electronic
- marking and grading: increase in the quality of their job but reduction in numbers

COMPUTER-RELATED

Positive

- computer specialists
- data processing
- computer group formed
- data processors
- computer systems analyst and electronics backgrounds
- CNC programmers
- process planners
- data terminal operators
- administrative with computers
- computer operators

Negative

- decrease in local computer staff - now a central system
- finance - accounting due to computers

MARKETING/SALES STAFF/MANAGEMENT

Positive

- production management
- supervisory and management positions
- management
- administrative support
- upgrading management

TESTING/QC

Positive

- food science

Negative

- takes the drudgery out of testing and allows them to spend more time on more interesting things
- testing because now integrated

PACKAGING

Positive

- packaging - new line

Negative

- packaging staff

MAINTENANCE

Positive

- electronic maintenance
- equipment maintenance
- maintenance
- maintenance with technological background

Negative

- track maintenance, equipment maintenance of rolling stock

DESIGN/ENGINEERS

Positive

- industrial engineering (sales increased because product more price competitive
- mechanical and electrical engineers
- engineers
- industrial engineers
- engineers
- electrical instrumentation engineering
- design
- industrial engineering and support staff

Negative

- draftsmen

OTHER

Positive

- in all areas, net increase of 125% over 5 years
- jobs increased because business up (3)
- technology has changed jobs but not displaced people
- two jobs due to increased complexity
- more semi-skilled
- all positions because business has grown
- as we modernize every job category increases - we modernize to do more business not to reduce workers
- always increasing jobs, never laid off a person in Winnipeg
- have gone from a R & D firm to an electronics manufacturer which resulted in doubled staff
- have become better at what we do, which has resulted in increased jobs
- with more automation will increase number of jobs

Negative

- switch from solid bronze bearing to roller bearings
- have been able to retrain
- not due to technology
- unskilled labor (7)
- laser technology caused decrease in jobs but demand and ability to produce has improved so have actually expanded.
- automation (due to)
- repetitive tedious tasks from secretarial to assembly.
- due to economy not technological change
- because of emphasis on efficiency and improvement in productivity
- because of economy not because of technological change
- semi-skilled laborers (2)

NO CHANGE/NO/NOTHING (54)

- We have not really been affected that much to this point in time. If we do not modernize our equipment and keep up with the trends I think it will definitely affect us evenly. Up until now there has been no real effect with the use of conventional equipment.
- (Technological Change) has resulted in more stabilization in manufacturing process - for efficiency. We subtract those manufacturing steps that we cannot complete - has done away with the need for casual hiring and firing of staff which once characterized this operation.
- Hand layout virtually disappeared - No decrease in jobs resulted as lower production costs improved our position in the marketplace and our sales increased.
- Not many changes - working in preventative maintenance, scheduling improvements - tried to use people we have.
- Had postive effect in some areas, negative in others but has balanced out.
- do more with the same number of people - trained our own people
- Newly established plant (2).
- Where technology has occurred on the line it has been to increase productivity not decrease jobs.
- Staff not affected by technological improvements.
- Change in jobs but not employees - improved quality of environment.
- Machining system displaced jobs but no employees lost.
- Grown in volume so held staff at same.
- Markets have grown to compensate for possible job loss due to technological changes.
- Most innovations that are introduced are to decrease labour rather than increae it. Have added automated equipment and a malting furnace and in terms of jobs we have probably held employment the same because we've been able to increase volume.
- In the last 5 years there has not been much change in the type of people required or the type of jobs that they perform because of technological change. All of our people have had to be better educated - it's been upgrading of the jobs instead of the occupations (ie: welders vs industrial welders).

NO RESPONSE (17)